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ENVIRONMENTAL PROTECTION RESEARCH CATALOG. ADDENDUM TO PART I

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ADDENDUM TO PART I

ENVIRONMENTAL PROTECTION RESEARCH CATALOG

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND MONITORING
RESEARCH INFORMATION DIVISION
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The Office of Research and Monitoring in the Environmental Protection Agency recently supported the publication of an "Environmental Protection Research Catalog." This catalog was prepared by the Smithsonian Science Information Exchange from information taken from its Notices of Research Projects. During the printing of the catalog a mechanical error caused 265 project descriptions to be omitted from Part 1. (Numbers 4.0349 - 4.0614) Even though they were not printed, all of these projects were indexed in Part II of the catalog.

This addendum contains all of the missing projects and should be used as a supplement to Part 1. Please excuse any inconvenience that this error may have caused.

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4. PESTICIDES

4.0349, TRANSFORMATIONS OF INSECTICIDES BY PLANTS

R.E. MENZER, Univ. of Maryland, Agricultural Experiment Sta., *College Park, Maryland* (MD-H-085)

OBJECTIVE: Identify the products of degradation of insecticides by plants and determine the quantitative significance of these products; determine the absorption and translocation of insecticides and their degradation products by plants; investigate the mechanism of decomposition of insecticides by plants.

APPROACH: Metabolic pathways of dimethoate in plants vary with the method of application. The metabolic pathways resulting from different methods of application (cut stem, foliar, soil, and plant macerate) will be studied using C -labeled dimethoate (-CH -side chain). Chromatographic methods and chemical degradation utilized to characterize metabolites. Study made of the persistence of the major metabolites. Enzyme systems that accomplished the metabolism of dimethoate will be investigated. Electrophoresis and a Warburg apparatus will be utilized.

PROGRESS: Metabolism of dimethoate- P and dimethoate-carbonyl- C studied in bean plants using 4 modes of application. Degradation of dimethoate occurred most rapidly in excised leaves, followed by stem- injected, root-treated, and least rapidly in foliar application. Oxygen analog, a cholinesterase-inhibiting metabolite of dimethoate, was consistently present in moderate amounts in plants treated by all 4 modes. Des-N-methyl dimethoate, a metabolite not previously reported as a product of dimethoate degradation, was detected in trace amounts, while 2 unknown metabolites, possibly the N-hydroxymethyl derivatives of dimethoate and its oxygen analog, were found only in foliar-treated plants. Oxidation of dimethoate took place to a lesser degree than hydrolysis, although it seemed more important in the foliar-treated plants than in the other. Major hydrolytic metabolites formed were dimethoate carboxylic acid, dimethyl phosphorodithioic acid, and dimethyl phosphorothioic acid. Des-O-methyl dimethoate, found in very high concentrations in previous studies of dimethoate metabolism in plants, was detectable in trace quantities. Metabolism of dimethoate-N- methyl- C investigated in bean plants using the foliar method to determine the identity of the unknown metabolites detected. All of the metabolites in the oxidative sequence were detected: dimethoate oxygen analog, the N-hydroxymethyl analogs of dimethoate and dimethoate oxygen analog, and the des-N-methyl derivatives of dimethoate and dimethoate oxygen analog.

SUPPORTED BY U.S. Dept. of Agriculture

4.0350, USE OF HERBICIDES TO CONTROL WEEDS IN FORAGES

J.V. PAROCHETTI, Univ. of Maryland, Agricultural Experiment Sta., *College Park, Maryland* (MD-B-079)

OBJECTIVE: Determine effect of time of application of 2,4-DB on herbicidal injury to alfalfa. Develop systems for the effective use of herbicides in established alfalfa for yellow rocket. Determine the mode of entry of CIPC into chickweed. Investigate the effect of CIPC on established grasses.

APPROACH: Applications of 2,4-DB will be made at various times of the year in order to investigate injury to alfalfa. The mode of entry of CIPC into chickweed will be studied; root, shoot or both will be ascertained by exposing these to CIPC. Established grasses will be treated with CIPC and the effects on yields will be recorded. New systems of weed control in established alfalfa will be developed using new herbicides.

PROGRESS: Chickweed is a major winter weed problem in Maryland. The following herbicides were applied as a spray or impregnated on a dry fertilizer: diuron, simazine, GS 14254, and chloropropham. In addition, a sprayed application of dichlobenil, dinoseb, and terbacil were studied. Late winter applications of the lower rate of sprayed and fertilizer impregnated simazine and GS 14254 were superior to the same rate of diuron. In general, none of the treatments significantly affected alfalfa yields; terbacil was the only herbicide to completely eliminate orchard grass.

SUPPORTED BY U.S. Dept. of Agriculture

4.0351, BIOLOGICAL ACTIVITY AND MODE OF ACTION OF HERBICIDES USED ON CORN, SOYBEANS, AND TOBACCO

J.V. PAROCHETTI, Univ. of Maryland, Agricultural Experiment Sta., *College Park, Maryland* (MD-B-117)

OBJECTIVE: Determine the effect of herbicide combinations and cultural treatments on crop and weed populations and herbicide residues. Study the effect of formulations, carriers, and methods of application on the efficiency and activity of herbicides. Study factors affecting the selectivity of herbicides on agronomic crops.

APPROACH: Herbicide combinations and cultural treatments will be evaluated under field conditions on corn, soybeans, and tobacco. Weed control, crop injury, soil residue, and method of applications will be studied. Selective action of trifluralin will be investigated with soybeans, a tolerant species, and susceptible species.

PROGRESS: Numerous field experiments were conducted on the biological activity of herbicides for selective weed control in corn, soybeans, and tobacco. In corn, best nutsedge control resulted from butylate, 3 lb/A preplant incorporated plus atrazine, postemergence 1 lb/A, with 1 gal Sun oil 11E when nutsedge was 1 inch high. Canada thistle was controlled by atrazine, 2 lb/A preplow on foliage, plus atrazine, 2 lb/A, preemergence. In soybeans, chloroxuron postemergence at 1.5 lb/A plus adjuvant controlled morning glory. Selective tobacco herbicides studied were benefin, nitralin, and diphenamid. In laboratory studies the uptake of C-trifluralin from treated soil was measured in germinating soybean, okra, grain sorghum and wheat seeds. Trifluoro-methyl labeled herbicide was uniformly incorporated in a Lakeland sandy loam at 1/4, 1/2, and 1 ppm with four replications. Seedlings were removed after 12, 36, 60, and 84 hr. Herbicide uptake was independent of imbibition because maximum radioactivity per gram dry tissue occurred at the 60 hr. treatment. Germination was between 12 and 36 hr. A direct coefficient of 0.9 existed between herbicide uptake and treatment rates. Susceptibility to trifluralin was not based on uptake since no significant difference occurred when species were compared on an equal weight basis. Uptake by individual soybean seed approximately tripled that contained in the seed of the other species.

SUPPORTED BY U.S. Dept. of Agriculture

4.0352, EFFECTIVENESS AND RESIDUAL PROPERTIES OF SEVERAL HERBICIDES USED IN TURFGRASS AREAS

A.J. POWELL, Univ. of Maryland, Agricultural Experiment Sta., *College Park, Maryland* (MD-B-107)

OBJECTIVE: Determine effectiveness of new and promising herbicides in eliminating weed competition from turf areas. Study effects of repeated use and high rates of herbicides on turfgrasses and residual weed control.

APPROACH: Replicated experiments will be set up in various locations throughout the state. New and promising herbicides for grassy and broadleaf weeds will be applied at several rates. Population density evaluations for weed control effect on desira-

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ble species will be made. Plant response over a period of several months to two years will be recorded. Bioassay will be run where applicable.

PROGRESS: Expt. A. - Accumulation of Crabgrass Preemergence Herbicides in Soils: After four yearly applications of bensulide, tricalcium arsenate, and DCPA, crabgrass control was excellent; however, near 50% of the established turf was lost on the tricalcium arsenate treated plots. Terbutrol, Bandane, and Benefin also caused considerable damage to the bluegrass-red fescue turf. Bandane resulted in good crabgrass control but caused considerable turf injury, e.g. a 60% turf cover and a very thatchy, shallow rooted turf. Siduron resulted in better crabgrass control than Bandane, Benefin or Terbutrol. Tricalcium arsenate gave best broadleaf weed control but Bensulide and Siduron gave near equal control. Overall quality (appearance, % turf cover, crabgrass and broadleaf weed control) was best with Bensulide, Siduron and DCPA. These results substantiate present Maryland recommendations and do not indicate that chemical residue carryover will injure turf. Expt. B - Annual Bluegrass Control: Control was erratic. Weather conditions during summer of 1969 were not conducive for this experiment.

SUPPORTED BY Maryland State Government

4.0353, INVESTIGATIONS OF ALFALFA INSECTS, THEIR BIOLOGY AND CONTROL

A.L. STEINHAUER, Univ. of Maryland, Agricultural Experiment Sta., *College Park, Maryland* (MD-H-071-D)

OBJECTIVE: Study of the biology and control of insect pests of forage crops with special emphasis on alfalfa insects. Studies of the alfalfa weevil, its life history, food preferences, behavioral characteristics and also its control with chemicals will be conducted. In addition control studies on pea aphid, meadow spittlebug and potato leafhopper will be undertaken. Information on insecticide residues on hay crops collected.

APPROACH: Experiments on the nutritional value of various host plants of alfalfa weevil will be performed, as well as an evaluation of plant extracts as oviposition and feeding stimulants.

PROGRESS: Field tests were conducted to evaluate recommended insecticides as well as candidate insecticides for the control of the alfalfa weevil. Results indicated that of the currently recommended materials, Methoxychlor failed to provide adequate control. Of the candidate materials, Furadan and Supracide were significantly better than any recommended insecticides, and Baygon, U.C. 34096, Bay 78537, AC 72016 and Herc. 9418 showed significant promise to warrant further consideration.

SUPPORTED BY Maryland State Government

4.0354, BIOLOGY AND CONTROL OF VEGETABLE INSECTS

M. TYSOWSKY, Univ. of Maryland, Agricultural Experiment Sta., *College Park, Maryland* (MD-H-097)

OBJECTIVE: Evaluate new chemicals for controlling vegetable insects and explore feasibility of so-called integrated control methods.

APPROACH: New insecticides will be tested in small plots of mixed vegetables. Non chemical methods such as reflective aluminum paper, photodynamic action of stains and dyes, viral sprays, and adhesive coated traps will be compared. Emphasis will be placed on obtaining detailed information concerning the biology and ecology of the sweet potato flea beetle and other selected insects.

PROGRESS: Studies have been underway to determine the most effective method of using granular systemic insecticides to protect direct seeded tomatoes from early season damage by flea beetles and Colorado potato beetles. Some of these systemics when placed below the seed caused reduction of plant growth. If these systemics were first broadcast on the soil, incorporated and then the seeds sown, no growth reduction occurred. Plots treated with either DiSyston, Dasanit plus DiSyston, Esso 6624 or Furadan granules consistently produced higher yields of tomatoes. Tests were also conducted using commercial insecticides and biological control agents such as Bacillus thuringiensis and polyhedrosis virus to control insect pests on crucifers. With the exception of B. thuringiensis, insecticides such as Monitor, Fundal and Lannate were more effective than the biologicals in controlling the pests. The effectiveness of the virus in controlling cabbage looper was enhanced by the addition of chemicals which altered the environment on the plant leaf surface. Studies were continued into the biology and control of sweet potato flea beetles. Adults have been found hibernating in the soil duff of sweet potato fields. Granular insecticides applied in July were evaluated for their effectiveness in controlling the beetles at the time of their peak activity.

SUPPORTED BY U.S. Dept. of Agriculture

4.0355, CONTROL OF ROOT ROT DISEASES OF GREENHOUSE FLORICULTURAL AND VEGETABLE CROPS

W.J. MANNING, Univ. of Massachusetts, Agricultural Experiment Sta., *Amherst, Massachusetts* 01002 (MAS00300)

OBJECTIVE: Determination of the root pathogens involved. Determination of the roles of more than one isolate in pathogenesis. Assessment of the effects of resistant and susceptible floricultural and vegetable plants on initial and later levels of soil-borne pathogens in steamed and natural soils. Development of effective and economical control measures.

APPROACH: Determine root rot pathogens in diseased root system and soil samples from greenhouse beds and fields. Most common isolates will be tested for virulence and control of greenhouse conditions. In vitro and in situ methods will include paired culture studies, buried slides, and immunofluorescent staining. Quantitative and qualitative data will be obtained.

PROGRESS: Extensive isolations have shown that Rhizoctonia solani and Fusarium spp. are the principal causes of root diseases of major floricultural and vegetable plants. Thielaviopsis basicola is a serious pathogen only of poinsettia and cyclamen. Verticillium, Pythium, and Phytophthora are not major pathogens at present. Cylindrocarpon radicicola was found associated with wilt of florists' azaleas. This is the first report of this disease problem in the United States. A tomato variety has been shown to be susceptible to several Fusarium spp. other than F. oxysporum f. sp. lycopersici. These other Fusarium spp. and isolates of F.o.f. sp. lycopersici of varying degrees of virulence, in association with R. solani, have been implicated in a synergistic, midseason, canker/wilt disease of several tomato varieties. Mechanical damage in the transplant stage also appears to be a factor in midseason Fusarium wilt of tomatoes. The influence of culture media on growth, sporulation, and virulence of isolates of F.o.f. sp. lycopersici of varying degrees of virulence is being investigated. Single and repeated drench applications of Captan, Dexon, and Dexon-Terraclor to established poinsettia plants were evaluated in response to widespread controversy over their effects on poinsettia development. Phytotoxicity was not observed and higher levels and repeated applications of Dexon and Dexon- Terraclor resulted in more extensive, disease free root systems than all other treatments.

SUPPORTED BY U.S. Dept. of Agriculture

4.0356, EFFECTS OF BIOLOGICALLY ACTIVE CHEMICALS ON PLANT GROWTH AND DEVELOPMENT

M.J. BUKOVAC, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL00935)

OBJECTIVE: Determine the mode of entry, transport, accumulation and metabolism of biologically active chemicals. Study effects of biologically active compounds on physiological processess which may result in the accumulation and/or utilization of metabolites.

APPROACH: The absorption and transport of selected economically important plant growth substances will be determined with radiosotope techniques. Metabolic sites of accumulation will be established through autoradiography. Having identified sites of accumulation, the metabolism of the absorbed chemical will be followed through tracer, chromatographic and bioassay techniques.

PROGRESS: Studies on factors affecting the penetration of naphthaleneacetamide (NAAm) into pear leaves and techniques for isolation of leaf cells for use in uptake measurements have been stressed. NAAm has been developed as a commercial

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chemical thinning agent for pears. Variability in response from year to year has been related, in part, to differential uptake. Penetration was followed from a solution, of known characteristics, contained in a glass cylinder attached to a leaf disc. Penetration through the upper surface was linear with time (96 hr.); whereas NAAm penetration through the lower surface was rapid for the first 48 hr. and then the rate decreased. Significantly more NAAm penetrated through the lower than upper surface. Increasing temperature from 5 to 35 C resulted in a marked increase in penetration; the most significant increase between 25 and 35 C. Light did not increase penetration through the upper surface, however, penetration was increased through the lower with increasing light intensity up to 300 ft-c and, thereafter there was no further increase. There was a direct linear relationship between concentration applied and penetration. Penetration was enhanced as the solution dried. This effect appears to be a function of concentration as the aqueous phase was lost. NAAm was not affected by pH. Surfactants enhanced penetration to a greater extent than can be explained by a reduction of surface tension.

SUPPORTED BY U.S. Dept. of Agriculture

4.0357, NUTRITION AND ENVIRONMENT OF FLORAL CROPS

W. CARPENTER, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL00625)

OBJECTIVE: Develop and standardize methods of identifying nutritional disorders in horticultural plants. Establish nutritional leaf values by spectographic determination. Determine nutritional requirements of horticultural plants grown under the influence of supplemental CO(2).

APPROACH: Plants will be grown in sand or solution cultures and nutritional level of macro and micro-metabolic elements will be analyzed. Plants will also be grown under varying environmental conditions (e.g. CO(2)) in order to determine the effect on growth.

PROGRESS: The effect of temperature on Sub-Terminal Bract Colorations of Stoplight Poinsettia was studied. It was determined that the temperature immediately after panning of 60 or 65 for at least 50 days, gave the largest amount of coloration. Temperatures of 70 , at this stage, decreased the number of subterminal colored bracts. A new formulation of 'Termil' called 'Exotherm' for control of Botrytis, was tested for phytoxicity on Poinsettias. It was found that no damage occurred to any of 12 poinsettia cultivars tested below 65 F. However, above 70 the varieties Ruth Ecke and Paul Mikkelsen were excessively damaged and minor damage occurred on many of the other varieties.

SUPPORTED BY Michigan State Government

4.0358, DUTCH ELM DISEASE

J.H. HART, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL01034)

OBJECTIVE: The objective of this project is to develop an effective control program for Dutch elm disease.

APPROACH: Systemic Pesticides - To develop a compound which will move systemically within elms, which will either be toxic to the pathogen or to the vector, which will be non-toxic to elms and other desirable forms of life, and which is reasonable in cost. Biological Control Agents - To determine the influence of native and introduced parasites and predators on elm bark beetle mortality. Improved Vector Control - To develop more satisfactory methods of applying the less persistent insecticide, methoxychlor, and to determine more precisely by laboratory and field studies its effectiveness in controlling elm bark beetles. Tree Selection and Breeding - To develop by selection and/or breeding elm cultivars which are genetically resistant to Dutch elm disease.

PROGRESS: Tests with Benlate used as a systemic fungicide were conducted in Flint, Michigan. Benlate is highly toxic to C. ulmi and can move systemically in elms. However, a satisfactory method of application has not been developed. The field evaluation of the introduced parasite, Dendrosoter protuberans, as a biological control agent for Scolytus multistratus was continued. This parasite does not appear to influence the number of bark beetles which overwinter. Methoxychlor residues in elm twig crotches was measured after various methods of application. Work continued on developing a disease resistant elm with over 25,000 seedlings now ready for screening.

SUPPORTED BY U.S. Dept. of Agriculture

4.0359, INVESTIGATIONS OF MINT DISEASES

M.L. LACY, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL00037)

OBJECTIVE: Evaluate sources of resistance, cultural practices, and methods of eradication of causal fungus in control of Verticillium wilt of mint.

APPROACH: Test mint hybrids and mutants for resistance to Verticillium wilt, continue investigation of cultural practices designed to alleviate severity of disease; investigate feasability of using fumigants to eradicate fungus from soil.

PROGRESS: Investigations of chemical weeding were continued but results on post-emergence applications of terbacil herbicide were inconclusive because of excessive moisture. It was determined that this herbicide had a residual life of two years for most crops except potatoes. Attempts to control Verticillium wilt by spraying stolons with benomyl fungicide were unsuccessful. Experiments to assess effects of herbicide application on severity of wilt were begun.

SUPPORTED BY U.S. Dept. of Agriculture

4.0360, CHEMICAL WEED CONTROL IN FIELD CROPS

W.F. MEGGITT, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL00960)

OBJECTIVE: Determine the cost of varying weed populations in terms of yield reduction and to evaluate factors involved in possible increases in cost of production. Evaluate the effect of certain herbicides on the quality and residue potential in food and feed. Determine changes in weed spectra that result from chemical and non- chemical methods of control. Evaluate combinations of herbicides and the addition of certain adjuvants to reduce the total amount of herbicide and still retain the initial impact on weed control. Study and establish growth habits. physiological and morphological factors that will offer an insight to points in the life cycle of weeds where more effective control will be obtained from less chemical or fewer cultural control measures. Evaluate chemical methods of weed control in conjunction with certain cultural and management practices to reduce total amount of chemical used.

APPROACH: A study will be made of the yield reduction under varying weed populations. The effects of herbicides on quality and residue potential will be considered.

PROGRESS: Several combinations of herbicides and methods of application provided 100% weed control in sugar beets. It is possible to produce sugar beets without hand labor for weeding. Pyrazon plus TCA applied preemergence followed with pyrazon plus phennidipham post emergence or pyrazon dalalpon were most effective. Non-phytotoxic crop oils increased effectiveness of postemergence treatments in corn and sugar beets with oils being again 8-10% more effective. A mixture of 80% oil and 20% surfactant at 1 qt/A was equal to 1 gal/A of oil. Combination of herbicides provided equal control and less soil residue than single treatments since each material can be used at lower rate. Fall panicum and witch grass, two late-season weeds, that are becoming more prevalent in corn were controlled with preplant applications of butylate and preemergence applications of alachlor. Corn varieties and inbred lines showed differential response to butylate with certain varieties showing injury under field conditions. Alachlor and linuron applied preemergence proved to be most effective new combination in control of annual weeds in soybeans. Amiben, linuron and combinations thereof continued to be effective.

SUPPORTED BY U.S. Dept. of Agriculture

4.0361, PESTICIDES AND GROWTH REGULATORS FOR FRUIT CROPS

A.E. MITCHELL, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL00246)

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OBJECTIVE: Develop seasonal pesticide programs for tree fruits interacted with growth regulating substances and methods of application to evaluate compatibility of chemicals, possible morphological and physiological injuries, and economical feasibility.

APPROACH: Design studies to include theoretically ideal combinations of pesticide chemicals and growth regulating substances for use at certain times during the growing season on pome and drupe fruits, and apply these chemicals as diluted and concentrated mixtures. Evaluations will include yield and fruit quality, visible phytotoxity to tree and fruit, degree of pest control, and the influence of the pesticides on the performance of the growth regulating substances.

PROGRESS: Studies were carried on in 1969 to determine (1) the effectiveness of concentrate spray applications to control mites during the growing season and to evaluate injury to the fruit as related to the concentration of the spray mixture. It was found that miticide spray applications of 8X-1/10 gallonage were as effective in control of mites as a long concentration of 3X-1/3 gallonage. The use of the high concentration also reduced the amount of chemical required for mite control by 20 percent and reduced the injury to the fruit.

SUPPORTED BY   Michigan State Government

4.0362, RELATION OF ENVIRONMENT AND CHEMICALS TO PHYSIOLOGY OF POME AND DRUPE FRUIT

A.E. MITCHELL, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL00116)

OBJECTIVE: Determine: environmental conditions (notably temperature and relative humidity) and time during flower and fruit development that fruit russeting is most likely to occur from use of spray chemicals; if injury to epidermal cells of developing flower and fruit is necessary for occurrence of russeting by various pesticide chemicals; relation between varieties of apples and injury resulting from various combinations of spray chemicals as influenced by temperature and humidity; interrelation of plant regulators used to control pre-harvest fruit drop and night and day temperatures on rate of fruit ripening.

APPROACH: Study in 1961 the interactions of vegetative vigor of the apple tree the predisposure of the developing fruit to an air temperature of 32 F. or lower close to bloom, and the use of certain pesticide chemicals following pre-disposure to freezing air temperatures on the unfavorable russeting of the fruits at time of ripening. The study will include the varieties, Golden Delicious and Jonathan.

PROGRESS: The study to determine the influence of different combinations of fungicides on yield, fruit size and finish of Bartlett pears was continued in 1969. Contrary to the findings of 1968, there were no differences in 1969 in fruit finish, size and yield. However, it will require 4 to 6 growing seasons to bring out any physiological influences from pesticide use.

SUPPORTED BY   U.S. Dept. of Agriculture

4.0363, PHYSIOLOGY AND BIOCHEMISTRY OF HERBICIDE ACTION, SELECTIVITY, AND DEGRADATION

D. PENNER, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL03065)

OBJECTIVE: Determine for several pre-emergence herbicides, their effect on physiological functions unique to germinating seeds in order to obtain information on herbicide action and selectivity, their concentration in cell components at various times after application, and the factors controlling herbicide metabolism.

APPROACH: Determine the influence of herbicides on activity and synthesis of hydrolytic enzymes unique or found primarily in seedlings, this includes determination of herbicidal influence on nucleic acid metabolism, herbicide concentrations in various cell fractions of herbicide treated plants, and environmental and chemical factors influencing the enzyme systems responsible for herbicide degradation.

PROGRESS: Several factors contributing to the unpredictability of herbicide performance were studied. Increasing the temperature resulted in increased atrazine phytotoxicity, whereas it often decreased triflualin toxicity. In the presence of high but non-toxic levels of phosphate the suppression of corn or squash seedling growth in the dark by amiben or atrazine was increased. This was not due to increased herbicide uptake or changes resulting in increased inorganic phosphate content. The level of phytase, the enzyme responsible for the early release of stored phosphorus in the germinating seed, increases rapidly during germination. However, the inhibition of this increase by atrazine and amiben was greater if non-toxic levels of phosphate were also present. Similarly the presence of the insecticide carbofuran increased the phytotoxicity of the herbicides linuron, butylate and Maloran. A test system was established for the assay of the influence of herbicides on nucleic and metabolism and subsequent regulation of plant metabolism. The bacterial toxin, syringomycin was shown to inhibit RNA synthesis. PENNER,D., J.E.DEVAY, and P.BACKMAN 1969. The influence of syringomycin on ribonucleic acid synthesis. Plant Physiol. 44: 806-808.

SUPPORTED BY   Michigan State Government

4.0364, CHEMICAL WEED CONTROL IN HORTICULTURAL CROPS

A.R. PUTNAM, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL00909)

OBJECTIVE: Establish herbicide practices compatible with crop culture and human health. Determine methods for control of weeds which have become dominant with current herbicide practices. Investigate mechanisms responsible for changes in nutrient composition from use of certain triazines, ureas and amides. Determine methods for reducing rates of application for highly phytotoxic and long residual herbicides.

APPROACH: Establish practices for commercially important crops by studying: times, rates, and methods of application; effect of cumulative applications of herbicides on residue in crop and on current and succeeding crops. Study control of weeds which have become dominant under present herbicide practices, i.e. quackgrass, bindweed, horsenettle and Canada thistle. Determine mechanism by which simazine increases the nitrogen content and growth by utilizing algae and tree fruit species; and mechanism through which diphenamid affects growth of tomatoes.

PROGRESS: New herbicides or combinations which were effective on vetegable crops were VCS-437, VCS-438, and terbacil on asparagus; phermediphan on beets; propachlor, alachlor, BAS2903H, and C6989 in cabbage; C6313 and prometryne in muckland celery; ACP65-81B and ACP65- 81B and bensulide in cucumbers; CDEC and Chlorprophane and RH-315 in lettuce; napththalene and dinoseb or DCPA in conjunction with clear plastic mulch in melons; BAS2903H and propachlor on muckland onions; ACP65-81B, C6989, alachlor, and propachlor on beans; C6313, SD15418, and butylate on sweet corn; and EL-179, bensulide, and ACP65-81B on seeded tomatoes. C6989, RH-315, and phenmediphane were promising on strawberries. Linuron and norea were effective in peach nurseries. Fall applications of granular simazine or simazine amitrole-T were effective under fruit trees. Three year repeated herbicide applications had no harmful effects in apple, cherry, peach and plum orchards, although some resistant weed species were on the increase, promising herbicides for ornamentals were norea and alachlor on gladiolus, norea and G513638 on ground covers, and trifloralin, 6513638, diphenemid, and granular EPTC on bedding plants. Greenhouse studies revealed two potentially dangerous pesticide combinations to use on vegetables.

SUPPORTED BY   U.S. Dept. of Agriculture

4.0365, ECOLOGY AND METABOLISM OF PESTICIDES BY SOIL MICROORGANISMS

J.M. TIEDJE, Michigan State University, Agricultural Experiment Sta., *East Lansing, Michigan* 48823 (MICL03084)

OBJECTIVE: Determine the importance of and the biochemical mechanisms responsible for metabolism of pesticides by soil microorganisms, pathways by which chlorinated aromatic compounds are metabolized, and the importance of the interaction of microflora and microfauna in the decay of plant residue.

APPROACH: Utilize cometabolizing soils, growing microbial cultures, resting cells and cell-free extracts to determine the

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basis for cometabolism of a pesticide molecule. Radioactive carbonaceous substrates will be utilized to determine rates of and total decomposition by soil flora and fauna.

PROGRESS: A soil bacterial culture has been isolated which will readily cometabolize (m over 1)- chlorobenzoic acid when grown on benzoic acid. The pathway of degradation has been shown to involve 4- chlorocatechol as a major intermediate by BLC, TLC, UV, and IR analyses. A similar halogenated catechol appears to be formed from (m over -)- bromo and (m over -)- iodobenzoic acid metabolism. When 4- chlorocatechol is used as a substrate for resting cells, very little degradation occurs. A second major intermediate appears as a distinct I(2) absorbing spot on TLC. This spot has been purified by preparative TLC and examined by GLC, UV, IR and mass spectrometry. These analyses suggest it is non-aromatic, is aliphatic and contains carbonyl and hydroxyl groups. The product, however, will not run through GLC columns as either the TMS or methyl-ester derivative. Both the 4-chlorocatechol metabolite and the unidentified metabolite are degraded by an Arthrobacter sp, known to possess the ability to metabolize aromatic compounds by 'ortho' cleavage. Mixed cultures of organisms obtained from the Red Cedar River have been shown to cometabolize chlorinated anilines while growing on aniline. These very toxic chlorinated anilines are totally decomposed with significant release of the chloride ion.

SUPPORTED BY Michigan State Government

4.0366, WEED CONTROL IN SOYBEANS

R.N. ANDERSEN, Univ. of Minnesota, Agricultural Experiment Sta., *Saint Paul, Minnesota* 55101 (MIN-13-039)

OBJECTIVE: Improve methods of weed control in soybeans. Increase the reliability of herbicide treatments so that the crop can be grown in narrow rows without cultivation.

APPROACH: Field, greenhouse, growth chamber, and laboratory studies will be conducted on methods of improving weed control in soybeans. Primary emphasis will be on chemical methods of control.

PROGRESS: A three-year study of the effects of chloroxuron (a postemergence herbicide) on the yield of weed free soybeans was completed. Soybean yields were not greatly reduced by twice the recommended rate. Soybeans were delayed in maturity, but a date of harvest study (simulating earlier frost) suggested that this delay may not be a serious problem. Chloroxuron was again excellent for wild mustard control in evaluations in a weed nursery. This weed nursery is being maintained on a continuing basis for soybean herbicide evaluations. Field plot studies appear to confirm earlier greenhouse findings that the danger of atrazine carryover might be reduced by planting large-seeded soybeans.

SUPPORTED BY Minnesota State Government - Saint Paul

4.0367, NON-TOXIC OIL SPRAYS TO CONTROL LEAF DISEASES OF CROPS

L. CALPOUZOS, Univ. of Minnesota, Agricultural Experiment Sta., *Saint Paul, Minnesota* 55101 (MIN-22-039)

OBJECTIVE: Determine whether non-toxic oil sprays can replace hazardous chemical fungicides for effective control of leaf diseases of sugar beets and other important crops.

APPROACH: Inoculated plants will be sprayed with various oils by several application methods to determine optimum conditions favoring disease control by oil. Search for possible phytotoxic effects of oil sprays to the host plant. Cooperate with extension service to demonstrate to growers feasibility of using oil sprays for commercial control of leaf disease. Study mode of action by which oil sprays control disease.

PROGRESS: In the greenhouse, mineral oil applied in low volumes reduced stem and leaf rust diseases on wheat seedlings. The results indicate that oil has protective and therapeutic properties. The oil inhibited stem rust more than it did leaf rust. Field trials confirmed that low volume oil sprays can significantly lower the incidence of rust in wheat plots; however, the oil reduced wheat yields because of phytotoxicity. In contrast to rust, the incidence of Septoria nodorum lesions was increased by mineral oil sprays. This phenomenon may provide us with a field technique for inducing man-made epidemics of S. nodorum in wheat nurseries which is needed for finding sources of genetical resistance to this pathogen.

SUPPORTED BY U.S. Dept. of Agriculture

4.0368, TOXIC CHEMICALS IN PLANTS AND THEIR RESIDUAL EFFECTS

A.J. LINCK, Univ. of Minnesota, School of Agriculture, *Saint Paul, Minnesota* 55101 ()

Amiben (3-amino-2,5-dichlorobenzoic acid) exhibited very strong 'auxin-like' activity in a tobacco callus test on solid media. The physiological range of amiben concentration which is able to induce callus tissue or organ formation is up to 200 mg/l. The responses of the tissue to various concentrations was different. For example, root formation begins at a concentration of 2 mg/l to 10 mg/l. At higher concentrations no organ formation was observed. Maximum callus growth (undifferentiated cells) occurred between 10 and 25 mg/l.

Tobacco callus tissue provides good material for the bioassay of amiben since the tissue showed exponential growth between 18 and 24 days from the day of placing the explant on the media. Amiben has marked effects on the formation of callus tissue of monocots such as corn and iris. For corn callus (Minn. 519) the callus tissue growth and carotenoid pigment formation was very large at 25 mg/l, while abundent root formation, but poor callus growth occurred at 10 mg/l amiben. Callus tissue from Iris (var. Wedgewood) developed embryo-like structures and good callus tissue formation at 10 mg/l amiben.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0369, MICROORGANISMS IN THE RHIZOSPHERE AND EFFECTS ON PLANT GROWTH

E.L. SCHMIDT, Univ. of Minnesota, Agricultural Experiment Sta., *Saint Paul, Minnesota* 55101 (MIN-25-075)

OBJECTIVE: Identify and quantitate microbial metabolites in the rhizosphere; investigate the ecology of certain metabolite-releasing microorganisms in the rhizosphere; and link experimentally microbial metabolite production in rhizosphere to impact on the plant.

APPROACH: Plants (soybeans at first) will be grown in sterile soil in the apparatus described by Miller and Schmidt, Soil Sci. 100:267, 1965. Microorganisms with special physiological properties as nitrification or nitrogen fixation will be inoculated into the sterile root environment, singly or in mixtures. Microbial growth products will be sought in the soil after plant harvest using biochemical techniques and isotope labels. Plants will be analyzed to obtain evidence of the uptake of a microbial metabolite, and to detect specific consequences of the uptake to the plant. The metabolite producing organism will be observed in soil by direct microscopy using fluorescent antibody techniques.

PROGRESS: Simulated atrazine residue studies were continued for the third and final year. Oat stand reductions by atrazine have been consistent from year to year and location to location. From 1/3 to 3/4 lb/A of atrazine were required to reduce stands of oats by 50%; from 1/2 to 1 3/4 lb/A to reduce yields by 50%. Most of the variation in yield could be predicted by May 15 from variations in stand reductions, average spring precipitations, and average spring air temperatures. Warm, wet springs, which stimulated tillering, favored the recovery of oats from atrazine injury. Stand reduction was related only to the amount of atrazine present. In the soybean herbicide interaction plots results were similar to last year. Stand reductions were inconsistent with yield reductions. Atrazine injury was most acute in linuron plots requiring from 3/4 to 1 1/2 lb/A atrazine to reduce yields by 50%. Similar yield reductions in other interaction plots (trifluralin, amiben, CDAA) required 1 1/2 to more 2 lb/A atrazine to reduce yields by 50%. Atrazine injury was least acute in trifluralin plots, at the lower rate (1/4 lb/A) atrazine consistently stimulated soybean yields. Phosphorus-atrazine interaction studies in the laboratory continued. Phosphorus apparently enhances the uptake of atrazine by soybean shoots. Experiments to evaluate the best conditions for pot studies were performed.

SUPPORTED BY U.S. Dept. of Agriculture

4.0370, EQUIPMENT FOR IMPROVED CONTROL AND PRECISION OF APPLICATION OF AGRICULTURAL CHEMICALS

M.R. SMITH, Univ. of Minnesota, Agricultural Experiment Sta., *Saint Paul, Minnesota* 55101 (MIN-12-014)

OBJECTIVE: Study and evaluate fundamental factors influencing drift and inadequate control from application of agricultural chemicals; develop quantitative information and criteria for design or selection of application equipment, operating conditions, chemical formulations, and environmental climatic conditions which permit application of chemicals without exceeding required cultural levels or tolerance levels on nearby crops; evaluate new application equipment design characteristics and techniques for improved precision and efficiency of chemical application.

APPROACH: Quantitatively describe applied chemical deposition forces and determine particle impact distribution for specified application conditions. Use information in simulation of ground applicators to predict probability of coverage at required density of a target area under varied operating conditions. Resulting related design information will be used to evaluate experimental pesticide application requirements.

PROGRESS: Experimental verification of an analog computer simulation of spray ejection from a nozzle into an airstream under moderate evaporation conditions was completed in the laboratory using a wind tunnel and spray sampling system. A sampling scheme which permitted consideration of a selected segment of spray entering the airstream was utilized for determination and comparison of the droplet size distributions produced by differenct evaporation conditions and airstream velocity gradients. The system model was also programmed for solution by digital simulation to permit further validation of the analog solution. Verification data did not conclusively establish the proper incorporation of the evaporation function in the model but did indicate that the analog computer predicted values adequately describing the influence of imposed velocity and evaporation on droplet trajectories. The simulation was used to determine variation in droplet path for an experimental velocity profile and for various levels of carrier evaporation. Predicted relations were established in terms of final droplet diameters at coordinate distances from the nozzle release point. The computer permitted rapid determination of the corresponding initial diameters for droplets at each terminal location.

SUPPORTED BY Minnesota State Government - Saint Paul

4.0371, WEED CONTROL IN SORGHUM

B.L. ARNOLD, North Miss. Branch Expt. Sta., *Holly Springs, Mississippi* 38635 (MIS-V-0105)

OBJECTIVE: Determine if herbicides can replace cultivation for weed control in sorghum. Evaluate the efficiency of weed control and the effect on crop production. Residual toxicity of herbicides used will be subjected to bio-assay tests. Field evaluation of weeds controlled or not controlled, crop yields, costs in general, and any other pertinent data.

APPROACH: Land preparation, fertilization, and insect control will be uniform on all plots. Treatments and rates are subject to change.

PROGRESS:

SUPPORTED BY Mississippi State Government

4.0372, WEED CONTROL IN SOYBEANS

B.L. ARNOLD, North Miss. Branch Expt. Sta., *Holly Springs, Mississippi* 38635 (MIS-SV-0104)

OBJECTIVE: Determine if herbicides can replace cultivation for weed control in soybeans. Evaluate the efficiency of weed control and the effect on crop production. Residual toxicity of herbicides used will be subjected to bio-assay tests. Field evaluation of weeds controlled or not controlled, crop yields, costs in general, and any other pertinent data.

APPROACH: Land preparation, fertilization, and insect control will be uniform on all plots. Treatments and rates are subject to change.

PROGRESS: Several herbicides were compared for their effectiveness in controlling weeds in soybeans.

SUPPORTED BY Mississippi State Government

4.0373, THE USE OF HERBICIDES FOR WEED CONTROL IN COTTON

B.L. ARNOLD, North Miss. Branch Expt. Sta., *Holly Springs, Mississippi* 38635 (MIS-SV-0102)

OBJECTIVE: Determine if herbicides can replace cultivation for weed control in cotton. Evaluate the efficiency of weed control and the effect on crop production. Residual toxicity of herbicides used will be subjected to bio-assay tests. Field evaluation of weeds controlled or not controlled, crop yields, costs in general, and any other pertinent data.

APPROACH: Land preparation, fertilization, and insect control will be uniform on all plots. Treatments and rates are subject to change. Herbicides used will be the best for cotton tolerance or a particular weed.

PROGRESS: Several herbicides were compared for weed control in cotton. All of the herbicides used were already released and on the market. It has had the practical value of demonstrating to producers some of the values and problems of the various herbicides.

SUPPORTED BY Mississippi State Government

4.0374, ABSORPTION, TRANSLOCATION, AND METABOLISM OF HERBICIDES BY CROP AND WEED SPECIES

A.W. COLE, Mississippi St. University, Agricultural Experiment Sta., *State College, Mississippi* 39762 (MIS-3-206-1456)

OBJECTIVE: Study the absorption and translocation of herbicides in major crop and weed species of Mississippi. Study the metabolism of herbicides by major crop and weed species of Mississippi. Attempt to identify metabolites and mechanisms of metabolism of herbicides in species found to metabolize herbicides in objective 2.

APPROACH: Plants will be grown in a phytotron. Autoradiography and radioisotope methods will be employed to study absorption and translocation and metabolism of radiolabeled herbicides. If a species is found to metabolize a herbicide, attempts will be made to determine and characterize the mechanism(s) of metabolism.

PROGRESS: Observation of field cucumber plots indicated that certain varieties were more resistant to injury from herbicide application than others. Four varieties were established in a growth chamber under uniform light, temperature, humidity, and day length conditions and treated with herbicides to evaluate varietal variation. Repeated trials under uniform conditions indicate considerable variation between varieties, and repeated trials are also currently being used to determine the inheritance of the resistance if possible. Snap beans have responded to one chemical for the second growing season with more yield than can be explained by the amount of weed control present. Growth chamber and greenhouse efforts to explain their response have not been successful. The treatment of cocklebur contaminated cotton seed to kill the cocklebur seed without injury to the cotton seed has been successful. Several herbicides were involved in this test to determine the differential of absorption by the two seeds. Fall treatment of cypressweed with 2, 4-D, 2, 4, 5T and Toroan has shown that at certain stages of growth and at certain rates the chemical is translocated into the seed and will kill both the parent plant and seed crop.

SUPPORTED BY U.S. Dept. of Agriculture

4.0375, EFFECT OF INTENSIVE CROPPING ON CHEMICAL ACCUMULATION, YIELD & PROCESSING CHARACTERISTICS OF VEGETABLES

H.L. HAMMETT, Mississippi St. University, Agricultural Experiment Sta., *State College, Mississippi* 39762 (MIS-3-206-1332)

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4. PESTICIDES

OBJECTIVE: Determine the effect of intensive cropping on pesticide accumulation in soil and plant parts, determine the maximum season length for processing green beans, greens, spinach and tomatoes, and study the effect of harvest dates on quality of processed crops.

APPROACH: Tomatoes, spinach, turnip greens and green beans will be planted from April through December. Recommended chemical pest control measures will be followed. The crops will be harvested at regular intervals on a once over basis and will be frozen and canned. Samples will be analyzed for the appropriate agricultural chemicals over a five year period to determine pesticide accumulation in soil and plants. The products will be evaluated for field yield season length, and canned and frozen quality.

PROGRESS: Data collected in 1968 showed traces of DDT, Dacthal, Endrin, Dieldrin and Toxaphene were present in turnip greens, tomatoes and snapbeans grown on soils containing these pesticides. Pesticide content was significantly higher in frozen than in canned products. Crops, of which vegetative tissue was the part used, contained greater amounts of pesticides than those where reproductive structures were present. Results indicated a strong climatic influence on pesticide uptake. Incomplete data for 1969 indicated a slight decrease in amount of pesticide present in the soils except for Dacthal which was the only pesticide listed that was applied in 1968. Other pesticides that were applied in 1968 and 1969 were Sevin, Malathion and Treflan, none of which were found in soil or crop samples. Analyses of the raw product in 1969 strongly support the conclusion based on the 1968 results. Analyses of the processed products are incomplete at this time.

SUPPORTED BY U.S. Dept. of Agriculture

4.0376, REDUCTION OR ELIMINATION OF ADVERSE EFFECTS OF PESTICIDE RESIDUES ON FOOD AND FEED PRODUCTS

L.T. KILGORE, Mississippi St. University, Agricultural Experiment Sta., *State College, Mississippi* 39762 (MIS-3-206-1266)

OBJECTIVE: Study food and feed products with respect to the location and persistence of pesticide residues in market products. Improved techniques for the detection, removal and/or neutralization of pesticide residues will be explored.

APPROACH: Samples with known histories of pesticide applications will be subjected to various handling and processing treatments. Effects on residue reduction by washing, cooking, and freezing will be studied. The location and persistence of malathion and other organic phosphate pesticide residues will be studied in broccoli which has been spray-treated with these pesticides.

PROGRESS: Fall broccoli plants that were sprayed weekly at the rate of 2.5 pounds of malathion per acre were harvested at daily intervals for 1 to 4 days after spray applications. The plants were cut in half with one portion analyzed raw and the other portion was blanched and frozen at -9 C. The frozen broccoli was stored for 6 months 3 days and then it was removed and analyzed. All plants showed considerable disappearance of malathion residue. The rate of disappearance seemed to be directly related to the number of days between spraying and harvesting. Plants harvested one day after malathion application lost 45.4% of the residue during freezing and storage. Plants harvested 2, 3, and 4 days after spraying showed a 69.0%, 75.3%, and 76.7% loss respectively. Frozen plants however contained significant amounts of an unidentified matabolite that may still be toxic.

SUPPORTED BY U.S. Dept. of Agriculture

4.0377, TRANSLOCATION OF HERBICIDES IN NUTGRASS AND JOHNSONGRASS

G.D. WILLS, Mississippi St. University, Agricultural Experiment Sta., *State College, Mississippi* 39762 (MIS-SUW-0014)

PROGRESS: Nutsedge: Evaluations of various types of surfactants in combination with MSMA resulted in increased purple nutsedge control primarily with nonionics, predominantly within the genetic grouping -- esters of polyoxyalklene glycols. Increased nutsedge control was obtained with foliar applications of; ethrel at 1.5 lb/A applied prior to MSMA, NIA-10637 at 6 and 12 lb/A applied in combination with MSMA and CP-41845 at 12 lb/A applied both prior to and in combination with MSMA. Commercially formulated herbicides in separate combination 1:1 with radiolabeled MSMAC foliar applied to nutsedge resulted in from 20 to 100% greater absorption and translocation of the radiolabel than occurred with MSMAC alone; in the order of effectiveness, high to low: fluometuron (80% WP), 2,4-D (alkanolamine salts 65% liq.), linuron (50% WP), diuron (80% WP), dalapon (Na salt 85%), dinoseb (65% liq.) and norea (80% WP). Johnsongrass: Foliar applications of ethrel to johnsongrass in both greenhouse and field research increased the level of control obtained with dalapon but not with MSMA. Acid vs ester formulations of ethrel were equally effective when compared with the herbicide on a molecular weight basis. Anatomical studies continue to suggest a correlation between herbicide response and anatomical composition of the plant. Generally those ecotypes most susceptible to dalapon also possess a higher proportion of xylem and phloem in the rhizomes.

SUPPORTED BY Mississippi State Government

4.0378, MICROBIAL DEGRADATION OF HERBICIDES

D.K. BAGGA, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUW-0108)

OBJECTIVE: Determine if soil microorganisms can degrade herbicides and if so, to isolate and identify the organisms responsible.

APPROACH: Laboratory studies will be conducted under controlled conditions to determine those soil microorganisms capable of degrading specific herbicides. Bioassay and chemical analyses will be used to determine the degree of herbicide deactivation in sterilized soil, nonsterilized soil, and sterilized soil inoculated with known microorganisms.

PROGRESS: Persistence of toxic levels of 3-(hexahydro-4,7-methanoindan-5-yl)-1,1 dimethyl-urea (norea), and 3-(m-trifluoromethylphenyl)-1,1-dimethyl urea (fluometuron) at 2 ppm in autoclaved and nonautoclaved soil was studied under greenhouse conditions. Norea was less toxic to soybean than fluometuron. Soybean bioassays revealed that norea and fluometuron persisted at toxic levels from 5-10 and 7-12 weeks, respectively, in nonautoclaved soil, while the toxicity of both the herbicides persisted even after 30 weeks in autoclaved soil. Addition of ground soybean leaves to nonsterilized soil hastened the disappearance of toxic effects of both the herbicides. A positive correlation between microbial population of soil and residual toxic effects of the herbicides in soil was observed suggesting the possibility of a microbial influence on degradation of these compounds.

SUPPORTED BY Mississippi State Government

4.0379, ADVANCED EVALUATION OF WEED CONTROL PRACTICES IN COTTON

R.S. BAKER, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUW-0019)

OBJECTIVE: Fully evaluate herbicide materials and practices so that recommendations can be made at the earliest possible date when weed control efficiency or crop tolerance exceed the standard practices being used.

APPROACH: As new herbicides or practices are proved successful in preliminary or secondary evaluation then they will be included in the advanced field evaluation plots.

PROGRESS: Evaluation of herbicides applied by different methods at the time of planting cotton disclosed several good compounds and led to the recommendation of fluometuron applied on the soil surface. Soil incorporated herbicides applied preplanting gave excellent grass control, but poor control on several broadleaf weeds led to the application of another herbicide at planting. Diuron or fluometuron combined with either nitralin or trifluralin provided the best weed control with no apparent injury to the cotton. Research led to the recommendation of this dual treatment with herbicides registered for such use. Research with EPTC has led to recommendations for its use in various ways in cotton and in the skip areas of skip-row plantings. The real utility of EPTC is its control of nutsedge although it is effective on a broad spectrum of weeds. For postemergence weed control, MSMA plus surfactant combined with diuron, norea,

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fluometuron, linuron, or prometryne controlled a broader spectrum of weeds under a wider range of weather conditions than any single herbicide. Directed sprays were preferable to overhead sprays for both weed control and crop safety. A single overhead application of MSMA plus surfactant before cotton was four inches tall reduced the yield of seed cotton slightly, but did not delay maturity nor affect the arsenic content in the seed.

SUPPORTED BY Mississippi State Government

4.0380, THE CONTROL OF WEEDS IN RICE BY THE USE OF HERBICIDES

D.H. BOWMAN, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUK-005)

OBJECTIVE: Determine an effective herbicide for the control of weeds in rice. Determine the rate, date, method of application and factors affecting the use.

APPROACH: Chemicals which have been given a preliminary screening will be tested in replicated field plots. Rates and time and methods of application will be studied.

PROGRESS: The rates and methods of application and general usage have been determined for propanil and molinate. Stauffer's R 3552 and Byram, Chipman 17623 and Elanco 119 appear promising for the control of grass. Chipman 17623, CIBA Preforam, Elanco 119, and Rhom & Haas TOK appear promising for the control of aquatics. However complete methods for their usage as well as the amount of plant residue have not been determined thus far. Of the many other chemicals evaluated none have proven satisfactory from the standpoint of weed control, crop injury and plant residue.

SUPPORTED BY Mississippi State Government

4.0381, INTERACTION OF COMBINATIONS OF HERBICIDES AND OTHER PESTICIDES IN COTTON PRODUCTION

H.W. IVY, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUW-0109)

OBJECTIVE: Determine the extent of injury to cotton from combinations of herbicides and pesticides as compared to the phytotoxicity of either alone. Evaluate new herbicide combinations marketed in the Mississippi Delta.

APPROACH: New herbicides and combinations will be evaluated in greenhouse or small field plots. Those showing promise will be evaluated in larger field plots, and, where appropriate, extensive field and laboratory experiments will be conducted, determine the most effective uses and hazards of the materials or methods. The most promising herbicides and pesticide combinations will be studied in field scale trials for adaptation to farm use where practical and economical.

PROGRESS: In an investigation of prickly sida control, combinations of preemergence and postemergence herbicides were studied. There were significant differences in control among the preemergence and postemergence treatments. The preemergence treatments were trifluralin fluometuron, trifluralin diuron, and trifluralin alone. Trifluralin fluometuron controlled prickly sida best. The best postemergence treatment was MSMA dinoseb applied twice. Of the herbicides which are registered for postemergence use in cotton, the best results were obtained with MSMA fluometuron on cotton five inches tall followed by MSMA prometryne on cotton eight inches tall. A two-year study using the insecticides phorate, disulfoton, and aldicarb with the herbicides trifluralin, nitralin, diuron, fluometuron, norea, and six dual treatment combinations of nitralin or trifluralin plus each of the phenylureas revealed a significant difference in seedling survival among herbicide treatments. Trifluralin diuron treated plots produced significantly greater yields than the nitralin norea treated plots. All other herbicide treatments were intermediate in effect on yield. Disulfoton treatments resulted in significantly higher seedling survival than phorate or aldicarb when all insecticides were applied at 0.75 lb/A in 1967. Aldicarb controlled thrips (Thripidae) best. Herbicide- insecticide interaction on seedling survival and yield was not significant. Insecticide treatments increased yield when thrips were present in sufficient number to damage young cotton.

SUPPORTED BY Mississippi State Government

4.0382, DEVELOPMENT OF PRACTICES FOR THE CONTROL OF ANNUAL WEEDS IN SOYBEANS

C.G. MCWHORTER, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUW-0101)

OBJECTIVE: Study the inter-relationship of herbicide rates, dates of application, and methods of application with regard to developing the most efficient weed control system for use in soybeans.

APPROACH: Individual treatments will be applied consisting of soil applied herbicides, foliar applied herbicides, or combinations of the two. Weed control will be determined by actual weed counts or by visual evaluation while crop toxicity will be obtained through visual evaluation and soybean seed yields. Emphasis will be given to field research in which both conventional and specialized application techniques will be evaluated.

PROGRESS: Excellent preemergence control of annual weeds in soybeans was obtained with BAY 94337 with essentially no crop injury. BAY 94337 appears to be one of the most promising herbicides ever evaluated at this location for annual weed control including cocklebur. Several commercially available herbicides were also evaluated, most of which controlled grasses and small seeded broadleaf weeds, although none provided adequate control of large seeded broadleaved weeds such as morningglory and cocklebur. Dinoseb, 2,4-DB and chloroxuron continued to provide excellent control of seedling weeds after soybean emergence. In most situations these herbicides are more effective applied postemergence than usage as preemergence treatments even though repeated applications are usually required for satisfactory postemergence control. Dinoseb and 2,4-DB must be applied in the early season as directed treatments for minimal crop injury. Maximum selectivity is also obtained with directed sprays of chloroxuron although this herbicide increased yields when applied topically in a salvage situation. Overhead treatments of chloroxuron plus paraffinic oil increased soybean injury as compared to similar treatments applied as directed sprays although topical applications may be of value when directed sprays can not be applied. Research with soybean strains continued to indicate a differential toxicological response between strains to 2,4-DB and 2,4-D. Certain strains appear to be more resistant to treatment with these herbicides and produced higher yields than commercially available varieties following herbicide treatment.

SUPPORTED BY Mississippi State Government

4.0383, SYSTEMIC INSECTICIDES FOR CONTROL OF COTTON PESTS

T.R. PFRIMMER, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUI-0006)

OBJECTIVE: Compare effectiveness of systemics with conventional sprays. Determine residual effectiveness of systemic action and determine the effect on stand.

APPROACH: Systemic insecticides in granular form are applied in the furrow with cotton seed at planting time or applied to the seed as a seed treatment using a dust or spray formulation. Counts are made on the number of insects present at periodic intervals following plant emergence. The number and species of insects controlled are recorded.

PROGRESS: Applied as granules with the seed at planting, disulfoton, GC-6506, Hercules 13462, NIA-10242, phorate, and Temik have all given fair to good control of thrips. Temik has been more effective and given longer residual control than any of the other materials. In some cases, the use of Temik granules at planting has resulted in earlier fruiting and increased yields. All materials have caused some stand reduction under adverse growing conditions. As liquid seed treatments, Azodrin, disulfoton, Hercules 13462, NIA-10242, and phorate have given fair to good thrips control. In general, seed treatments have not given as long residual control as granules, and they cause more stand reduction than granules. As a dust seed treatment, DuPont 1179 was ineffective for thrips control. Applications of disulfoton and phorate in the soil-incorporated preemergence herbicide treatments have failed to give thrips control. Temik granules applied as a side-dressing at the time cotton begins fruiting have shown promise for the control of boll weevils. In some cases, the side-dressing treatment has resulted in bollworm buildup. Liquid stem treatments of Azodrin or GC- 6506 when applied at the time cotton starts to fruit showed some promise for the control of boll weevils. All systemic insectiride treatments have resulted in varying periods of spider mite suppression. Temik has given as much as 3 months suppression of mites.

SUPPORTED BY Mississippi State Government

4.0384, STAND ESTABLISHMENT AND SEEDLING DISEASE CONTROL

C.D. RANNEY, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUJM-I)

OBJECTIVE: Evaluate effectiveness of seed treatment materials under Delta conditions; develop simple means of applying supplemental fungicides to reduce seedling disease losses; develop improved methods and equipment for planting cotton; evaluate and locate any chemical treatments that predispose seedlings to disease; select genetic materials with lower optimum temperatures for seedling growth.

APPROACH: Response of chemicals used for seed treatment to control seedling disease will be measured in terms of: stand 4-5 weeks after planting, uniformity of stand, rate of emergence, and yield of seed cotton. Identify treatments with any type chemicals reducing stands of seedling vigor. Utilize low temperature controlled chambers to identify lines of cotton that exhibit vigorous growth at 16-14 degrees C. Develop planting methods-equipment that will produce optimum conditions for seedling emergence and growth.

PROGRESS: Results indicate seed treatment with systemic insecticides irrespective of other treatments resulted in reduced stands. Use of systemic fungicides chloroneb or 2.3-dihydro-5-carboxanilido-6-methyl-1,4-oxathin in combination with systemic insecticides resulted in smallest reductions in stand. Several granular combinations of fungicides and disulfoton gave excellent seedling disease control and early season insect control. Where systemic insecticides were used a slight stand reduction was noted in comparison to just the fungicide treatment. Rhizoctonia solani was the predominant organism involved in stand loss.

SUPPORTED BY Mississippi State Government

4.0385, SOIL PLACEMENT OF HERBICIDES FOR WEED CONTROL IN COTTON

E.L. ROBINSON, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUWM-0001)

OBJECTIVE: Study the optimum herbicide rate and incorporation method for maximum weed control and minimum crop injury with promising herbicide candidates in cotton production.

APPROACH: Major emphasis will be devoted to field research. Experiments will be conducted to determine the pattern of soil incorporation possible with several mechanical incorporation devices. Other work will be conducted to determine the overall efficiency required when incorporating herbicides into the soil. Soil samples will be collected from field plots following treatments and various aliquots used to conduct a bioassay, or extract dye that was incorporated with the herbicide. From these data, incorporation patterns will be developed.

PROGRESS: A soil sampling technique was implemented in which a complete block of soil was extracted in two inch cubes and bioassayed. The average length of root from each soil sample demonstrated that a herbicide incorporated with a disc harrow may vary considerably in concentration from inch to inch and in length, width, or depth within the soil profile. Diuron 3-(3,4-dichlorophenyl)-1,1-dimethylurea and fluometuron 3-(m-trifluoro-methylphenyl)-1,1-dimethylurea applied preemergence to cotton and incorporated appears to be a promising treatment. Better weed control seems to occur in incorporated plots. However, a herbicide incorporated deep may cause injury to the cotton. The long range study on MSMA at 2, 4, 6, 8, 10, 16, 32, 64, and 128 lbs/A reveal that up to a point the material apparently disappears from the soil within one year. However, with very heavy rates some accumulation appears to occur. Of most interest will be herbicidal makeup of the lighter rate applied plots after repeated treatments. There does not appear to be a direct linear correlation between rate of MSMA applied and the level of arsenic one year later as measured by a standard chemical aresenic determination level. Rice appears to be one of the more selective plants to monosodium acid methanearsonate (MSMA). Even among the varieties of rice there appear to be some that exhibit greater sensitivity to MSMA than others. Of 75 or more rice varieties some 15 of these show more epinastic effects than did the others. The work is continuing and with a silica sand as the matrix differences between 5 and 25 ppm of MSMA can easily be demonstrated with some varieties of rice.

SUPPORTED BY Mississippi State Government

4.0386, EVALUATION & APPLICATION OF HARVEST-AID CHEMICALS ON COTTON PLANTS IN MECHANICAL HARVESTING

R.O. THOMAS, Delta Branch Experiment Sta., *Stoneville, Mississippi* 38776 (MIS-SUYM-0001)

OBJECTIVE: Investigate physiological factors involved in cotton leaf abscission and second growth. Investigate effectiveness of various defoliants, desiccants, and growth inhibitors on cotton. Investigate alteration of growth habit by chemicals and by pruning which will facilitate defoliation and mechanical harvesting.

APPROACH: Evaluate new defoliants, desiccants, and growth inhibitors for their potential use as harvest-aid chemicals. Evaluate the use of chemicals and mechanical pruning for tailoring growth and fruiting to requirements for efficient defoliation and mechanical harvesting.

PROGRESS: Greenhouse plants and field plots were utilized in experiments related to evaluation of experimental defoliants and desiccants in comparison with standard commercial formulations, the effects of additives on defoliant performance, bottom defoliation, pre- conditioning, economics of defoliation, and timing of defoliation with respect to plant maturity and harvesting efficiency. It was found that organophosphate defoliants excell other commercial defoliants in ability to remove both immature and mature leaves; desiccants are not as satisfactory as defoliants due to increase trash content of lint and burning of unopened bolls; additives do not increase defoliant efficiency under Stoneville conditions; bottom defoliation can impair boll maturity if spraying is done too early or too high on the plant; preconditioning, by adding low rates of defoliant to late insecticide applications, causes premature loss of upper leaves which are needed to feed late maturing bolls; economic studies show that defoliating large, leafy, high yielding plants prior to machine harvesting can raise the classer's grade of the fiber from Low Middling to Strict Low Middling Plus, a difference approximating $20 per bale at 1969 loan values; best time to defoliate is when 65 to 70 percent of the bolls have opened, or when the latest bolls contributing to yield are firm, difficult to cut with a knife, and the embryo completely fills the seed cavity.

SUPPORTED BY Mississippi State Government

4.0387, THE INTERACTION OF HERBICIDES WITH OTHER APPLIED PESTICIDES

H. IVEY, Mississippi St. University, Agricultural Experiment Sta., *Stoneville, Mississippi*

Problem & Need: This is an era of chemical culture of cotton. Chemicals are used to provide sustenance for plants and to control weeds, insects and deseases.

Upon application, these different chemicals may end up in approximate relationship on or in the soil and/or plants. The interaction of these may cause serious problems especially to stands and vigor of young plants. Also, through a direct chemical reaction and/or the influence of one material on the pest for which another material is applied as the pesticide, the effectiveness of a given chemical may be altered. In some cases one of the chemicals may interfere with the uptake of another. Furthermore, these interactions may be influenced by soil and weather conditions.

The Research: Research should be undertaken to evaluate the interactions of herbicides with fungicides, insecticides and ne-

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matocides and possibly other agricultural chemicals as to the effects on the cotton plant and on the efficacy of the individual pesticides. The efforts should be on a multiple discipline basis. Investigations should provide information on what pesticide combinations can be safely and effectively used under given situations. Ways to minimize the hazards through changes in application or use techniques should be developed and fundamental aspects of the interactions, both adverse and favorable should be examined. There may be a need for such work at more than one location since differences in soils, weather and cultural practices may affect the interactive behaviors of such materials.

SUPPORTED BY Cotton Incorporated - Raleigh, N.C.

4.0388, CHEMICAL WEED CONTROL IN COTTON

R.C. ALBRITTON, Northeast Miss. Ag. Expt. Sta., *Verona, Mississippi* 38879 (MIS-SX-0045)

OBJECTIVE: The use of herbicides for weed control in cotton without cultivation other than seed bed preparation. The production of cotton without post-emergence cultivation for weed control has many potential advantages over present day methods. The saving of time, machinery, man-hours, soil erosion, and lowering the cost of production would be great.

APPROACH: Determine if herbicides can replace cultivation for weed control in cotton. Evaluate the efficiency of weed control and the effect on crops production. Residual toxicity of herbicides used will be subjected to bio-assay tests.

PROGRESS: No progress reported this period (active project).

SUPPORTED BY Mississippi State Government

4.0389, PHYSIOLOGY OF GROWTH OF HORTICULTURAL PLANTS

D.D. HEMPHILL, Univ. of Missouri, Agricultural Experiment Sta., *Columbia, Missouri* 65201 (MO00129)

OBJECTIVE: Further elucidate the individual effects and interactions of photoperiod, temperature (day and night), chilling treatments on the growth and reproduction of horticultural plants. Determine level of auxins, gibberellins and inhibitors in the plant in relation to state of development, i.e., rest period, vegetative stage, reproductive stage; influence of environmental factors on level of indigenous growth regulators in the foliage of plants; the influence of synthetic growth regulator chemicals on vegetative growth, flowering and fruiting.

APPROACH: The strawberry plant will be subjected to different chilling, light and day and night temperature regimes. The relationship of the level of auxins, gibberellins and inhibitors to the growth responses of the plant will be studied.

PROGRESS: Growth retardants, Alar, CCC, MH, Ethrel and several experimentals were evaluated for growth retardation of 2 varieties of Kentucky bluegrass under growth chamber, greenhouse and field conditions. Alar, CCC and MH were relatively ineffective. Ethrel caused a stiff upright type of growth. Some of the coded experimental chemicals caused considerable reduction of top and root growth without visible injury while other caused chlorosis. Turf species differed in their response to a given growth retardant. Set and yield on greenhouse tomatoes grown during the winter months were not improved by combinations of Alar, CCC, gibberellins or Ethrel with p- chlorophenoxyacetic acid over that of the latter chemical alone. Alar (dimethylaminosuccinamic acid) was not effective in improving quality of Concord var. grapes exhibiting symptoms of 2,4-D injury. Cold hardiness of peach flower buds were not increased by Alar sprays in late summer or fall.

SUPPORTED BY U.S. Dept. of Agriculture

4.0390, CONTROL OF WEEDS IN HORTICULTURAL CROPS

D.D. HEMPHILL, Univ. of Missouri, Agricultural Experiment Sta., *Columbia, Missouri* 65201 (MO00146)

OBJECTIVE: Determine weed control efficacy and specificity of newly synthesized herbicides and their phytotoxicity to and adaptability for use in horticultural crops; study uptake, translocation and accumulation of herbicidal chemicals; the effects of herbicidal chemicals and their metabolic products upon the metabolism of the horticultural crops; and the fate of herbicides in soils.

APPROACH: Formulations of new herbicidal chemicals will be evaluated for effectiveness in weed control and for tolerance of the different horticultural species and varieties to these chemicals. Herbicides will be applied as sprays or granulars pre-emergence or post- emergence to the crop plant. Performance of herbicides will be correlated with temperature, soil moisture, soil type and soil fertility. Uptake and translocation of herbicides will be studied by radioisotope techniques.

PROGRESS: The bacteria population of the soil in a grape vineyard was reduced by ten annual applications of diuron. The level of diuron residue after ten annual treatments was less than 1 ppm. Perennial weeds such as climbing milkweed (Ampelamus albidus) have become an increasing problem in vineyards and beneath apple and peach trees. Control can be achieved beneath apples and peaches with 2,4-D; however, there was no effective and safe herbicide for the grape vineyard. Terbacil which has shown great promise for use in peaches caused severe chlorosis in several varieties of peaches and apricots when applied in July. Chloroxuron continues to give excellent results in new strawberry plantings. Maloran has shown promise also. Common Bermuda (Cynodon dactylon) and tall fescue (Festuca arundinacea) continue to be serious weed probems in turfgrasses. No selective control is available. Tordon alone or in combination with 2,4-D controls most all broadleaved weeds in bluegrass turf. Injury to trees and shrubs may result at rates above 1/4 lb/A., however. More satisfactory herbicides for cucurbits and tomatoes are needed. All available herbicides reduce yield of cucurbits and tomatoes when compared with hand-weeded controls.

SUPPORTED BY U.S. Dept. of Agriculture

4.0391, PRINCIPLES AND PRACTICES FOR CONTROL OF JOHNSONGRASS IN SOYBEANS

J.T. HOLSTUN, Univ. of Missouri, Agricultural Experiment Sta., *Columbia, Missouri* 65201 (0710-01-26(GR))

OBJECTIVE: Develop improved techniques of controlling johnsongrass in soybeans through new combination of known effective herbicides and cultural practices, and discover new herbicides that will selectively control johnsongrass in soybeans.

APPROACH: Comparatively evaluate several proven herbicide-cultural combinations, selected to provide differing levels of control pressure, in large, replicated field plots of soybeans heavily infested with established johnsongrass; characterize different genetic lines of johnsongrass and soybeans with respect to anatomy, physiology, and response to herbicides; and evaluate new herbicides, effect of spray volume, effect of herbicide placement, effect of application timing, and effect of additives to herbicides on the response of johnsongrass and soybeans to herbicides.

PROGRESS: Johnsongrass control continued to be better where both fall and spring plowing before planting soybeans were used in combination with several applications of herbicides. However, the soil of plots which received spring plowing only was less compacted, and absorbed more irrigation water than plots plowed in both the fall and spring. This compaction of soil could be very detrimental, and will require additional attention. The addition of nonphytotoxic oil (1 or 2 gal/A) to aqueous sprays of DSMA, dalapon, or diuron did not increase the phytotoxicity of the herbicides applied as foliar treatments to johnsongrass. Soybeans planted 5 days after application of dalapon at 7.4 lb/A were injured, but were normal if planting followed 20 days after application of the herbicide.

SUPPORTED BY U.S. Dept. of Agriculture

4.0392, EFFECTS OF DIURON (KARMEX) TREATMENTS ON PONDS

J.R. WHITLEY, State Dept. of Conserv., *Jefferson City, Missouri* 65102

Objectives: To determine the effects of diuron on aquatic vegetation, including filamentous algae and phytoplankton, and to measure the effects on water quality.

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Procedures: Field experiments will be conducted to determine which species of plants are affected by low level applications of diuron. Filamentous algae and planktonic algae will be collected before and after application for identification. The effects of treatment on pH, dissolved oxygen, alkalinity, conductance and turbidity will be measured.

Laboratory tests will be made to determine the contact time with diuron required to kill Elodea and Ceratophyllum. Tests will be conducted in one-half acre experimental ponds.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0393, RESPONSE OF PLANT COMMUNITIES TO SUSTAINED USE OF HERBICIDES

J.M. HODGSON, Montana State University, Agricultural Experiment Sta., ***Bozeman, Montana*** 59715 (MONB00333)

OBJECTIVE: Determine effects of repetitive application or persistent pollutional levels of herbicides on plant communities.

APPROACH: The purpose is to develop information on the influence of herbicides on ditchbank ecosystems. An attempt will be made to identify factors necessary to encourage desirable low-growing vegetation on ditchbanks and determine the possible contamination of irrigation water resulting from herbicidal treatments of ditchbanks ecosytems. Potential selective herbicides such as dalapon, amitrole, TCA, and dicamba will be applied annually to weed infestations on ditchbanks or to field-grown plantings of species from ditchbank ecosystems. Stand composition of plants before and after treatments will be evaluated by the line transect or quadrat count procedures. Treatments will be designed to encourage establishment low-growing grass species and control or eliminate tall-growing broadleaved or grass species that interfere with water delivery. Ditch water and soil samples will be analyzed for possible contamination.

PROGRESS: In this initial period plant materials have been established in the field and a review of the literature concerning the approach to this problem has been completed. The first data from this experiment will be obtained in the 1970 field growing season.

SUPPORTED BY U.S. Dept. of Agriculture

4.0394, IMPROVEMENT OF OIL SEED CROPS THROUGH THE DEVELOPMENT OF SUPERIOR VARIETIES AND CULTURAL METHODS

C.W. CROWELL, Eastern Mont. Agric. Exp. Sta., *Sidney, Montana* 59270 (MONB00555)

OBJECTIVE: Test new varieties of flax, safflower, soybeans, sunflowers, and other oil seed crops for total yield, oil quantity and quality. Determine seeding date, rate and fertilizer need for economical production in eastern Montana. Develop chemical and cultural weed control practices for oil seed crops.

APPROACH: Varietal test plots will be established for as many of the likely varieties and strains being produced by the plant breeders as possible. Four row plots, 10-20 feet long, randomized within the replications, will be the experimental design. Eight or 16 feet from each of the 2 center rows of each plot will be harvested for yield. Obtain data on plant height, vegetative characteristics, disease, and insect damage. The following nurseries will be grown using the most promising varieties from the varietal trials. Fertilizer trials to determine the most economic rates of application. Data of seeding trials to determine the optimum date of seeding. Rate of seeding trials to determine the optimum rate of seeding. Chemical weedicide screening and testing trials to determine toxicity to oil seed crops, the optimum rate of application and degree of weed control will be investigated.

PROGRESS: Windom was the highest yielding variety in a dryland flax variety yield nursery. Linott was the best of the new varieties. The recommended varieties, Redwood and Bolley, were intermediate as to yield. Safflower selections made at this Station for Alternaria resistance were grown in dryland and irrigated yield nurseries. The irrigated nursery was destroyed by root rot. None of the selections were resistant to the root rot. Significant differences in Alternaria resistance were noted in the dryland trial. Most of the selections yielded more than the susceptible variety, U. S. 10. Three Alternaria tolerant selections with promising oil contents were increased for possible release to safflower growers.

SUPPORTED BY Montana State Government

4.0395, RESPONSE OF PLANTS AND PLANT COMMUNITIES TO SUSTAINED USE OF HERBICIDES

C.R. HEISLER, Univ. of Nevada, Agricultural Experiment Sta., ***Reno, Nevada*** 89507 (NEV00109)

OBJECTIVE: Determine effects of repetitive application or persistent pollutional levels of herbicides on plant communities. Determine effects of repetitive application or persistent pollutional levels of herbicides on the structure, chemical composition, and function of individual species of the plant community.

APPROACH: The cytospectrophotometer will be used to quantitate cellular and nuclear concentrations of nucleic acids in treated and controlled plants. Histological preparations will be made of the root system of young peas. The effect of 2,4-D, picloram, dicamba and other growth regulator herbicides will be sought on the RNA and DNA concentrations. Specific enzyme levels and activities and the intracellular concentration of herbicides will be determined by the cytospectrophometer where possible.

PROGRESS:

SUPPORTED BY U.S. Dept. of Agriculture

4.0396, CONTROL OF POTATO PESTS

J.C. CAMPBELL, Rutgers the State University, Agricultural Experiment Sta., ***New Brunswick, New Jersey*** 08903 (NJ00358)

OBJECTIVE: Test various chemicals for the control of Fusarium sambucinum, Streptomyces scabies, Rhizoctonia solani and other organisms which may be involved in potato production. Determine if there is a pesticide effect on potato flavor. Study means of reducing tuber bruising and cutting from harvest to grading and packing.

APPROACH: Various chemicals will be applied to fields known to be infested with the organism involved and data obtained on degree of control. Freshly cut seed pieces will be inoculated and various chemicals applied for control. Data will be obtained on degree of control obtained. The harvesting, grading, packing, filling storage and removing potatoes from storage will be studied to determine when and how tubers are damaged.

PROGRESS: To control soil-borne scab, Streptomyces scabies, Chemagro 4497 at 10, 15, and 20 lbs/A was broadcast and Foundation Chippewa seed planted. Plant emergence and yields were not affected. Chemagro 4497 0 15 and 20 lb/A resulted in tubers of poor flavor. To control Rhizoctonia solani infection of tuber lenticels Terraclor Super X was broadcast at 12.5 and 25 lb/A and chippewa seed was planted. Plant stands were not affected. Tubers from untreated plots and those treated with 25 lb/A active Terraclor Super X were 98% disease-free and those receiving 12.5 lb/A were 99.3% disease-free. Since few tubers were infected in the untreated areas, the data are not sufficient. Freshly cut Chippewa seed was treated with fungicide dust formulations to inhibit tuber-decaying fungi and planted 10 days later. Seed treated with Polyram gave 97.6% germination, 4% more than untreated seed and 8% greater than Dithane M45-treated seed. 58% of the untreated seed pieces were firm and 16% were decayed. Seed treated with Daconil Captan, Polyram and Difolatan were 92, 88, and 88% firm. Dithane, Difolatan, and Polyram treatments resulted in highest yields. Captan-treated and untreated seed gave lowest yields.

SUPPORTED BY New Jersey State Government - Trenton

4.0397, SURVEY OF NEW COMPOUNDS AND MIXTURES FOR BIOLOGICAL ACTIVITY

E.J. HANSENS, Rutgers the State University, Agricultural Experiment Sta., ***New Brunswick, New Jersey*** 08903 (NJ00441)

OBJECTIVE: Search for more effective and safer materials as pest control agents that are effective against a wide spectrum of insect species, mites, nematodes, and plant disease causal agents.

APPROACH: Using previously developed methods, screen test an average of 35 chemicals each month.

PROGRESS: About 40 experimental compounds were screened for biological activity on the two-spotted spider mite and for phytotoxicity on coleus. Six formulations of SBP 1382, a promising new pyrethrin-like material, were tested on five dif-

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ferent surfaces to determine their length of activity against German roaches. Eleven aerosols were tested for phytotoxicity on greenhouse grown cucumber, tomato, and snap-bean plants. Five aerosols were tested for phytotoxicity on a number of vegetable and ornamental plants in field tests. Most of these formulations did not burn plants seriously.

SUPPORTED BY New Jersey State Government - Trenton

4.0398, WEED CONTROL IN FIELD AND HORTICULTURAL CROPS

R.D. ILNICKI, Rutgers the State University, Agricultural Experiment Sta., *New Brunswick, New Jersey* 08903 (NJ00141)

OBJECTIVE: Develop safe, effective, and economic methods for controlling weeds in field and horticultural crops.

APPROACH: Studies will be conducted in the field and greenhouse using acceptable statistical designs. Measurements of crop response to herbicides as well as weed control responses will be recorded. Crops which will be studied will include the following: corn (field and sweet), beans (lima, snap, field), small grains (wheat, barley, oats), potatoes, cole crops (cauliflower, broccoli, cabbage), spinach, leafy greens (collards, kale, turnips), transplanted and established strawberries, and small-seeded legumes (alfalfa, clovers, birdsfoot trefoil).

PROGRESS: Many label-approved and new experimental herbicides were evaluated for weed control and crop tolerance in agronomic and horticultural crops. The crops studied included newly-seeded and established alfalfa, field and sweet corn, the large-seeded legumes - soybeans, lima beans and peas; the cereal crops - wheat and barley; the solanaceous crops - tomatoes, potatoes, peppers and eggplant; the cucurbits - cucumbers, squash and cantalope; the leafy vegetables lettuce, endive and spinach; onions and broccoli. These investigations were conducted in existing research facilities at Adelphia and Centerton and in growers fields. Several methods of herbicidal application were investigated - preplant incorporated, preemergence, and postemergence. Rates, formulation and combinations of herbicides were also investigated. Presently recommended herbicides and application techniques served as controls. From the many studies conducted, many changes, including additions and modifications, in our present recommendations have been made; others are being considered.

SUPPORTED BY New Jersey State Government - Trenton

4.0399, VEGETABLE INSECT INVESTIGATIONS

B.B. PEPPER, Rutgers the State University, Agricultural Experiment Sta., *New Brunswick, New Jersey* 08903 (NJ00405)

OBJECTIVE: Investigate procedures for control of insects attacking vegetables, effects of insecticides with respect to yields, quality, residues and phytotoxicity, biology and habits of vegetable pests.

APPROACH: New chemicals will be examined. Effects of chemicals on vegetable quality and residue analyses will be conducted. Development of insect resistance to current controls will be investigated.

PROGRESS: Potato - 10 formulations tested. Torak gave excellent control of Colorado potato beetle, increased yield by 74 cwt. Temik 3 lb/A applied to soil at planting gave excellent control of beetles and aphids and increased yield by 105 cwt. No objectionable off-flavors. Sweet Corn - 14 formulations tested. Lannate 1 lb/A gave excellent control of European corn borer, corn earworm, and corn leaf aphid. Azodrin 1 lb., Phosvel 1 1/4 lb. and Gardona 3/4 lb. Parathion 1/4 lb. per acre were excellent on borer but only fair on earworm. Gardona 1 1/2 lb/A was excellent on borer but was conducive to high aphid populations. Broccoli - 11 formulations tested. Lannate 1 lb., and Monitor 1 lb. per acre gave excellent control of cabbage looper. Galecron 1/2 lb., Fundal 1/2 lb., BT(Bacillus thuringiensis) Nutrilite Products BTB-183 3 lbs., BT Amdal - Good 1/2 lb., Fundal 1/2 lb., Galecron 1/2 lbs. and Phosvel 1 lb. per acre were slightly less effective. Lettuce - 6 formulations tested. DDT 1 lb., Lannate 1 lb. gave excellent control of corn earworm and lygus bug. Gardona 1 1/2 lbs. gave excellent control of earworm but was less effective on lygus. Heavy aphid infestations occurred on the Gardona treatments. Performance data excellent for new chemicals. Lannate may be a good replacement for DDT on vegetable crops. Further performance and residue tests needed.

SUPPORTED BY New Jersey State Government - Trenton

4.0400, RESEARCH IN METHODS FOR TESTING ECONOMIC POISONS, FEEDS FERTILIZERS AND LIMING MATERIALS

S.B. RANDLE, Rutgers the State University, Agricultural Experiment Sta., *New Brunswick, New Jersey* 08903 (NJ00477)

OBJECTIVE: Specific present objectives are improvement of methods for organic arsenic, chlorinated hydrocarbons, and organic phosphates in pesticides, nitrogen in fertilizers, fiber in feeds and minerals in feed and fertilizers.

APPROACH: Further work on water insoluble nitrogen methods will be continued by extending the turbidimetric method to all types of fertilizer materials. Studies will be continued on methods for pesticides with particular emphasis on gas chromatographic techniques.

PROGRESS: Effort was continued on a method for the determination of residues of Temik insecticide on potatoes. All of the present methods have been evaluated and the useful parts adopted for the proposed procedure, which is still incomplete. A venting device has been devised and built into the gas chromatograph to ensure reproducibility of response. Numerous clean-up methods, columns and sets of conditions have been studied. It had been hoped that a system could be devised which avoided thermal degradation of this set of highly unstable compounds, but this has so far not been successful. This work should be completed in the near future. A procedure was developed for the determination of water-insoluble nitrogen in plant foods. Unground samples of fertilizer were washed in a column with the equivalent of 100 inches of water followed by a conventional nitrogen determination. The procedure eliminated the problem of determining WIN in particle size dependent sources, and allowed for evaluation without alteration of agronomic indices such as activity index.

SUPPORTED BY New Jersey State Government - Trenton

4.0401, PESTICIDES FLAVOR OF FOODS

E.F. STIER, Rutgers the State University, Agricultural Experiment Sta., *New Brunswick, New Jersey* 08903 (NJ00805)

OBJECTIVE: Ascertain the effect on flavor of various pre and post harvest treatments on vegetables and fruits. Assess for flavor new varieties of products developed in the process products for subsequent evaluation, develop methodology for flavor evaluation when and where needed. Provide a reliable sensory panel assist in assessing flavor problems for the College.

APPROACH: Samples for flavor evaluation will be submitted to the Food Science Dept. for processing or for controlled storage and evaluation at a subsequent date. A multiple comparison procedure will serve for evaluation of a series of samples and a triangle test technique will be used with a single treatment and checks sample set. Results will be expressed in terms of difference from a standard and will include panel preference as well as interpretation of data.

PROGRESS: Evaluations within the department made on soda samples with additives to ascertain whether or not additives passed from bottling material to beverage. Results positive. Screening on samples ripened at different R.H. indicated a less acid tomato when ripened at low R.H. over high. Same finding occurred with bananas. Completed evaluations on samples on corn, apples, peas and asparagus stored at five different temperatures for 12 months. Assessed for flavor and texture processed samples of 31 New Jersey pear selections. Evaluated 79 samples of fresh pears for flavor and texture. Evaluated 79 processed samples for both flavor and texture. Determined the effect of various insecticides on flavor of twelve samples of potatoes for Entomology. Evaluated the effect on flavor of a dozen fungicides on the flavor of tomatoes. Determined the effect on flavor of various vine killers on potatoes. Completed storage tests on the flavor effects of Vapona on tomato juice. Assessed the flavor of eight new varieties of tomatoes which show promise of fresh fruit; assessed the effect of trace elements on the flavor of papayas. Ascertained the effect on flavor of new sweetening agents on dietetic borscht produced by a New Jersey company. Developed a score sheet for subjective evaluation of frozen lobster which had been irradiated.

4. PESTICIDES

SUPPORTED BY New Jersey State Government - Trenton

4.0402, CRANBERRY DISEASES AND THEIR CONTROL

A.W. STRETCH, Rutgers the State University, Agricultural Experiment Sta., *New Brunswick, New Jersey* 08903 (NJ00372)

OBJECTIVE: New methods of fungicide application evaluation of new fungicides for disease control and effect on plant and fruit quality; effect of environment on disease development; fungal population dynamics as influenced by cultural practices; effect of plant nutrition on fruit rot; chemical changes in fruit associated with latency and subsequent development of fruit rotting fungi; determination of cause of virus-like ring patterns on cranberry fruit.

APPROACH: Field and laboratory experiments will be designed to determine cause, nature of losses and effective control measures for cranberry diseases. Etiology of major fruit rot diseases, including Guignardia, relationship of nutrition to incidence of fruit rots and associated chemical changes in fruit will be determined.

PROGRESS: A total of 5 plots in 2 different bogs were checked to determine fruit rot buildup when fungicides are applied by fixed-winged aircraft. There was an average of 4.2, 2.5 and 20.3% fruit rot, respectively, on aircraft sprayed, ground sprayed, and unsprayed checks. Results from a fungicide concentration test on the variety Early Black, indicate a reduced rate of maneb (3 lbs/A instead of 4.5 lbs/A) is as effective on Early Black as it was earlier demonstrated in Howes. All 6 fungicides tested tended to reduce yields. In a previous test (1964) maneb had significantly reduced yield at the 41/2 lbs/A rate, but in 1969 41/2 lbs was compared to 3 lbs/A. It was shown that 3 lbs did not significantly reduce yield whereas 41/2 lbs/A did. By using maneb at 3 lbs/A application better control at less cost is possible than when ferbam is used at 6 lbs/A. Fungicide applications are currently applied during the bloom period for fruit rot control. Late applications (approximately 1 month after bloom) were evaluated at 4 locations in 1969. Meaningful results were obtained at 1 of 4 test sites. Benlate and maneb significantly reduced fruit rot to 7 and 12% respectively, as compared to 22% in the unsprayed checks.

SUPPORTED BY U.S. Dept. of Agriculture

4.0403, INVESTIGATIONS IN INSECTS AND OTHER ARTHROPODS ATTACKING ORNAMENTAL PLANTS

H.T. STREU, Rutgers the State University, Agricultural Experiment Sta., *New Brunswick, New Jersey* 08903 (NJ00407)

OBJECTIVE: Study the biology and ecology of arthropods affecting ornamentals. Control important insect pests. Determine action of systemic insecticides on ornamental plants.

APPROACH: Biology and ecology pests studied in the field and laboratory. Life histories and relationships with other organisms determined to intergrate control. Control studies will provide data concerning plant growth response, pest response and effects on associated organisms. Systemic studies will determine types of organisms affected, length of time they are effective, and economics of control.

PROGRESS: Studies were continued on the relative cumulative effects of annual applications of certain pesticides over 7 years on turfgrass ecology. Counts of arthropods extracted from soil cores removed after 6 years treatment were completed. Results showed ethion had the greatest residual effect on Collembola, and carbophenothion the greatest effect following treatment. Chlordane affected both total mite and springtail populations. Surface arthropod activity was monitored using Fichter-type pitfall traps, and counts of weekly trap harvests showed greater total activity in chlordane plots. Chinchbug counts appeared as a bimodel distribution with activity peaks in mid July and a lesser peak in mid August. Chlordane treated plots showed significantly greater populations through the year; Xenylla sp. also numbering 2-3X the total number trapped in CK plots. Carbaryl and Zectran treated plots showed greatest resurgence in acivity following pesticide treatment. Heavy populations of Penthaleus major in winter and Bryobia praetiosa in spring were trapped and numbers correlated with heavy feeding damage in untreated plots, and lesser damage and lesser activity in ethion and carbophenothion treated plots. Suppression of nematode populations was again found in OP treatments.

SUPPORTED BY New Jersey State Government - Trenton

4.0404, RESPONSE OF PLANTS AND PLANT COMMUNITIES TO SUSTAINED USE OF HERBICIDES

J.W. WHITWORTH, New Mexico State University, Agricultural Experiment Sta., *Las Cruces, New Mexico* 88070 (NM00182)

OBJECTIVE: Determine effects of repetitive application or persistent pollutional levels of herbicides on plant communities; determine effects of repetitive application or persistent pollutional levels of herbicides on structure, chemical composition, and function of individual species of the plant community.

APPROACH: Determine distribution of residual levels of herbicides (substituted ureas, triazines, bensulide, and picloram) within the plant cell and identify sites of accumulation by conventional procedures of cell disruption, centrifugation and identification of electrophoretic, chromatographic, and spectrophotometric methods. The use of radioactive herbicides applied to plants in field and greenhouse experiments will permit correlation of morphological and physiological changes with levels of herbicides in sites of accumulation within the plant cells.

PROGRESS: Project initiated July 1969. Preliminary work has been completed on field layout and on the pollution potential of the persistent herbicides to be evaluated in rotation systems. Field experiments will be established in the spring of 1970 on the newly- acquired Plant Science Farm.

SUPPORTED BY U.S. Dept. of Agriculture

4.0405, PREPARATION AND BIOASSAY OF SMOKE CONDENSATE FROM TOBACCO SAMPLES

T.C. TSO, Health Research Incorporated, *Buffalo, New York* 14203 (0500-05-10(C))

OBJECTIVE: Determine the carcinogenic activity of smoke condensate from tobaccos of varietal, cultural, or curing differences.

APPROACH: Different tobacco varieties, produced with various levels of fertilizer or cured with different methods, were made into cigarettes. These cigarettes were smoked under specified conditions and smoke condensate collected for biological assays. These materials or fractions are tested by topical application to the shaved backs of animals. Both positive and negative controls will be used. At the end of the test period, animals showing evidence of tumor formation and/or associated pathological changes will be sacrificed, and autopsies, including histological examinations, will be performed to confirm the gross finding or provide other significant information.

PROGRESS: Studies with Penar have been pursued to the point where a dose response affect is now clearly demonstrable. Penar itself has no tumor initiating activity, and therefore is not a complete carcinogen. The inhibiting effect of T-148 on the promoting activity of Tween-80 is apparent. In the ICR Swiss mice a dose response of Tween-80 is apparent in the 0.3% to 1.0% range. From the results obtained so far it appears that among the sucker control chemicals tested on the same weight basis, Penar is the most active promoter, while Tween-80, Tween-20, T-148 and T-43 are less active, and MH-30 appears inactive. Of the other pesticides evaluated, Dyrene appears to be an active promoter after 23 weeks bioassay. The determination of the promoting activity of extracts from various tobacco samples was handicapped by the high nicotine concentration.

SUPPORTED BY U.S. Dept. of Agriculture

4.0406, SEASONAL OCCURRENCE AND CONTROL OF THE CORN EARWORM IN THE VALLEY

J.A. ADAMS, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00535)

OBJECTIVE: Field and cage studies on the occurrence, seasonal history, ecology and control of the corn earworm. Heliothis Zea, as a pest of sweet corn grown for the fresh-produce market. Tests of insecticides in commercial fields with emphasis on airplane application, incidental studies on the fall armyworm and other associated species of Noctuidae and Arctiidae.

APPROACH: By detection of the earliest brood, rearing, moth- trapping, temperature unit summation and other methods, to pin-point, several days in advance, the best date on which to initiate control operations. Studies to measure current population trends and adjust the spacing of insecticide applications economically. Observations on disease of the insect. Studies on northern corn leaf blight.

PROGRESS: The project provided a method of early detection and warning which was particularly important in 1969. The leader's practice of searching emerging tassels in late June (before there are ears) revealed earworms at a few per one thousand tassels in one field. Moths reared from these emerged in late July at which time the spray interval recommended for silk was shortened to 72 hours. At mid-August it was shortened to 48 hours in some of the larger corn farms, and remained at 72 on others. Effects were appraised by field inspectors up to harvest in various plantings. Recommended programs of insecticide application were continually reconciled with moth trap data from 2 black light traps located 20 miles apart. The project also included full commercial-scale airplane field tests of three insecticides which are possible substitutes for DDT, having the brand names: GARDONA, LANNATE and SEVIN. For the first two of these the experiment provided data to be used, if necessary, in testimony for official clearance for labelling under Federal regulations. The test with Gardona revealed a minor phytotoxicity problem which is to be corrected by the manufacturer in 1970.

SUPPORTED BY New York State Government - Albany

4.0407, BIOASSAY OF PESTICIDE RESIDUES ON FRESH FRUITS AND VEGETABLES

H. ARN, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00538)

OBJECTIVE: Determine pesticide content of raw products and processed foods. Study fate and toxicity of pesticides in plants.

APPROACH: It is proposed to conduct residue determinations by biological and radiotracer methods. Devise new methods and improve existing methods.

PROGRESS: Persistence of Aldicarb and Disulfoton on red raspberry after granular application was studied by laboratory bioassay of single leaves with Amphorophora agathonica to ensure continuance of control data in periods of low field populations of the aphid. Considerable variations were found within each plot. In general, control was optimal within 1-2 weeks after heavy rain and dropped near zero in dry periods.

SUPPORTED BY New York State Government - Albany

4.0408, BIOASSAY OF PESTICIDE RESIDUES ON PROCESSED FRUITS AND VEGETABLES

H. ARN, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00539)

OBJECTIVE: Determine by bioassay the amount of insecticide or fungicide residue in processed fruits and vegetables and the possible effects of food processing upon pesticide residues in these commodities.

APPROACH: Continued determinations of insecticide and fungicide residues in processed fruits and vegetables by bioassay. Also to be continued is study of the problem of pea strain identification by bioassay.

PROGRESS: No progress to report this period (active project).

SUPPORTED BY New York State Government - Albany

4.0409, SMALL FRUIT DISEASES CAUSED BY FUNGI OR BACTERIA

A.J. BRAUN, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00700)

OBJECTIVE: Control of black rot, downy and powdery mildew, and dead arm of grapes. Control of orange rust and powdery mildew of raspberries. Control of fruit rots and foliage diseases of strawberries. Detection of new fungal and/or bacterial diseases.

APPROACH: Test fungicides in field plots for control of diseases of grapes, raspberries and strawberries. Test effectiveness of roguing, isolation, and sanitation. Identify fungi and/or bacteria isolated from diseased plants and inoculate plants to establish pathogenicity.

PROGRESS: Excellent control of powdery mildew without phytotoxicity was obtained with Benlate on 10 different grape varieties. Benlate was shown to be compatible with Captan, Fermate, Thylate and Manzate D, at concentrations of the latter sufficient for the control of black rot or downy mildew. Super Cosan was more effective than Benlate in preventing late season powdery mildew infection on the varieties Concord, Missouri Riesling and Seibel 1000. However, it caused slight to moderate foliage injury on the Concord variety. In 3 tests, where conditions favored maximum development of powdery mildew, micronized sulfur at 2 lbs. per 100 gal. did not provide adequate control even where combined with Phaltan at 2 lbs. per 100 gal. The efficiency of a low-pressure sprayer with an 'over-the-trellis' boom for the application of either dilute or concentrate sprays was substantiated. Concentrate applications of Benlate or sulfur at 50 gal. per acre were more effective than dilute applications of the same amount of fungicide applied at 100-200 gal. per acre. Three applications of Benlate or of Morestan gave only partial control of powdery mildew in black raspberries. Sulfur was considerably less effective and caused severe foliage injury.

SUPPORTED BY New York State Government - Albany

4.0410, EVALUATION OF CHEMICAL FORMULATIONS AND ENERGY PROCESSES AS SEED TREATMENTS OF MAJOR CROP PLANTS

W.F. CROSIER, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00811)

OBJECTIVE: Discover or synthesize chemicals and formulate them into seed-treating materials for comparison with, and displacement of, mercurial and other highly toxic materials. Evaluate chemical formulations and energy processes that show promise of controlling seed- borne diseases. Measure the ability of chemical formulations to protect seeds and seedlings against soil-borne organisms.

APPROACH: Diverse formulations will be applied to selected lots of small grains primarily for the control of smut disease. Treated seeds will also be accepted from Winnipeg, Canada as part of a continuing cooperation project of the American Phytopathological Society. The seeds will be tested under field conditions for smut control. They will also be placed in paper towels so that phytotoxicity may be measured. Other portions of each lot will be sown in sterilized soil to determine if growth rates are affected in the absence of soil-borne fungi. Field corn and certain vegetable seeds will be treated with the non-mercurial formulations. The testing sites will be field, paper towels, contaminated soil and sterilized soil. A macrobiological assay (cold test) will be used to secure very adverse growing conditions.

PROGRESS: Both disinfectant and protectant groups of seed treatments were successfully used to control or reduce grain smuts, seedling blights and seed and seedling decay. Covered and loose smuts of susceptible cultivars of oats were controlled by a benzimidazole (Benlate) and an oxathiin (G-696) and reduced by 44 chemicals. Twenty one non-mercurial formulations were superior to the three most effective organic mercurials. Several formulations whose active ingredient was neither volatile nor systemic successfully contacted internally borne propagules of the smut fungi. Seeds of winter wheat purposely contaminated with spores of Tilletia foetida and treated with CHEM 4442, Merck 127-A, EP-347, or Panogen PX produced only healthy heads. The least effective of 50 other formulations reduced common bunt (T. foetida) from 24.2% untreated to 2.70%. Only 3 of the 54 formulations under test failed to reduce bunt to a 1.0% level. Only 1 of 17 experimental protectants was phytotoxic to squash seedlings. Ten formulations increased stands in the absence of major soil-borne pathogenes.

SUPPORTED BY New York State Government - Albany

4.0411, DETECTION OF CHEMICAL TREATMENT OF SEEDS IN SERVICE AND ENFORCEMENT TESTING

W.F. CROSIER, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00808)

OBJECTIVE: Determine if seed lots received in service testing are adequately treated to control seed- and soil-borne organisms. Examine seed lots received in enforcement of the state seed law for the presence of treatment materials. Classify pesticides present on seeds in terms of toxicity. Determine if abnormalities in germination were caused by chemical treatments.

APPROACH: All seed lots represented as treated will be examined visually at 50-125X for signs of a treatment substance. The control of molds during germination will be used as a measure of fungicide treatment. A microbiologic assay will be developed so that the distribution of a fungicide among the unit seeds of a sample can be measured.

PROGRESS: Colletotrichum gloeosporioides was determined to excel Aspergillus niger and Myrothecium verrucaria in sensitivity to mercurial compounds present on seeds. A species of Phoma isolated from barley seeds was found to respond to minute differences in mercury diffusing from seeds into gelated media. This fungus was readily cultured on the Geneva CMO medium and produced an abundance of pycnospores. G. cingulata accurately measured the relative amount of organic mercury present on seeds of red wheat. Dosage increments of 1/4 ounce/bushel in a 1/4 through 5/4 ounce bushel range were revealed by corresponding increases in the areas of inhibition zones created by G. cingulata. The correlation between dosages and areas of zones was not violated by size of seed, density of spores, condition of medium nor storage period prior to bioassaying. In an attempt to increase the spore production asparagine, microelements, extracts from cucurbitaceous and leguminous seeds and seedlings were added to Bell, Czapek, PDA, and Sabouraud media. The magnitude of increase in sporulation affected by extracts alone was 5- to 20- fold. Seeds of garden or lima bean produced 10- fold as many spores as the equivalent area of PDA medium alone. Every lot of rye and wheat examined for treatment was actually treated as represented. The presence of a chemical treatment was indicated by seed color, mercury poisoned seedlings and the absence of Alternaria tenuis.

SUPPORTED BY New York State Government - Albany

4.0412, CABBAGE MAGGOT AND ITS CONTROL

A.C. DAVIS, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00528)

OBJECTIVE: Determine control of the cabbage maggot in field seed beds of various cole crops.

APPROACH: Various methods of application will be studied; screening of phosphates as well as any newer insecticides available will be undertaken.

PROGRESS: Field testing of candidate insecticides for the control of cabbage maggot was carried out at two locations in 1969. The first was at North Collins in Erie County, and the second was at Greece in Monroe County. Three modes of application of candidate insecticides were tested on radish. Insecticides were incorporated into the soil as a pre-sowing treatment. Insecticides were sown in the seed furrow at the time of planting, and finally, insecticides were applied as drenches 10 days after planting. Generally materials gave best cabbage maggot control when applied in the open furrow or drench treatments. However, it is important to point out that plants are particularly susceptible to phytotoxicity when insecticides are applied on top of the seed. In many instances symptoms of phytotoxicity were apparent, evidenced by failure of plants to emerge. No such symptoms of phytotoxicity were seen when insecticides were applied as post-emergence drenches. Of the candidate insecticides tested in 1969 for cabbage maggot control, as in previous years, Dasanit and Furadan looked very promising, at both rates tested, and in all three methods of application. Zinophos and Dyfonate also looked good at the higher levels tested.

SUPPORTED BY New York State Government - Albany

4.0413, EVALUATION OF NEW INSECTICIDES FOR CONTROL OF CODLING MOTH

E.H. GLASS, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00500)

OBJECTIVE: Evaluate new insecticides for their efficiency for codling moth and other apple pest control, and determine their phytotoxicity, compatibility with other pesticides, minimum effective dosages and schedules, and harvest residues.

APPROACH: Conduct field and laboratory studies with candidate insecticides in suitably infested apple orchards.

PROGRESS: Ten experimental insecticides were evaluated against codling moth in a replicated experiment in an Experiment Station apple orchard using Guthion as the standard. All treatments were applied thoroughly with an orchard gun in five copper sprays at approximately two week intervals starting June 17 and finishing August 19. Gardona, Furadan, Zolone, Fundal, GS 6506, VCS 506, GS 18005, Hercules 14503 and UC 34096 were as effective against the codling moth as Guthion. The C 9491 plot was dropped early because of severe foliage injury. GC 6506 caused moderate foliage injury. Heavy wooly apple aphid populations developed on trees sprayed with UC 34096. Four additional insecticides (Folimat, UC 30045, SD 16898 and SD 17250) were evaluated on 2-tree unreplicated plots and were found to be very promising against codling moth. SD 17250 caused a ring shaped injury on 60 to 95% of the apples (McIntosh). The untreated checks were found to have 63 worms per 100 apples which is considered a very light infestation in the test orchard. Some of the experimental materials may be less effective during seasons more favorable to codling moth.

SUPPORTED BY New York State Government - Albany

4.0414, CONTROL OF ORCHARD MITES IN WESTERN NEW YORK

S.E. LIENK, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00513)

OBJECTIVE: Develop satisfactory early season and summer spray programs.

APPROACH: Major emphasis is being directed to the petroleum oils. These materials are apparently resistance-proof and in addition are effective against some minor insect pests on apple. Evidence obtained to date in the investigations of tree spray oils has resulted in altering the specifications from a 100-second to a 60-second viscosity product. These lighter oils are less phytotoxic and it is hoped that an even safer product can be developed.

PROGRESS: Studies in 1968 were limited to the European red mite. Although the two-spotted spider mite was present, infestations were local and sporadic in nature. Early season treatments were again emphasized. Four commercial apple plantings were utilized as test sites for these trials. Treatments were applied to acre size blocks with an airblast sprayer. Timing in relation to apple bud development and coverage were evaluated. It was determined that petroleum oil sprays can be effectively applied from the half-inch green to pink bud stage - a period of approximately 2 weeks. Seasonal control can often be attained with a single application, however, a pink application of demeton applied over an earlier oil spray enhances control. A series of 8 acaricides were evaluated as pink sprays in a Golden Delicious planting. All gave excellent control until the end of July. Galecron gave an additional 3 weeks of protection. In another test on Red Delicious, 8 acaricides were employed at reduced dosages in 3 sprays (pink, 1st and 3rd cover). UC 34096 and Galecron in this schedule gave seasonal control. A series of 27 acaricides were tested against established populations in late July. Of these Galecron, Fundal, Carzol, Plictran, UC 34096, Denin, Lovozal, H 14503, GS 19851, PCS 1301, TX 1219 and Bay 80530 exhibited excellent eradicative properties and warrant further testing. In 2 evaluations Kelthane w.p. failed to control the red mite whereas the EC formulation performance was good - only the EC will be recommended in 1969. Another population was found to be resistant to Trithion.

SUPPORTED BY New York State Government - Albany

4.0415, STUDIES ON VINEYARD TILLAGE

N.J. SHAULIS, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00737)

OBJECTIVE: Design and evaluate weed control procedures in the vineyard with the goals of maximum control (stimulation or retardation) and minimum cost in terms of soil retention as well as labor and material.

APPROACH: Determine the weed control, vine injury, fruit maturation, and herbicide residue in the fruit and vine afforded by 2,4- D formulations and by soil sterilants.

PROGRESS: The major weed problem consisted of weeds resistant to normal rates of diuron and simazine, and of these C.arvensis was most prevalent. An experiment with dichlobenil rate, time of application, formulation, and incorporation showed that only with incorporation at high rates did it show promise, comparable to use of 2,4-D wax bar treatment. There was a highly variable control of perennial grasses by simazine, dependent on both time of application and rainfall in period following application. The phytotoxic effects of a late 1967 application of sinbar persisted through October 1969 on Concord foliage.

SUPPORTED BY New York State Government - Albany

4.0416, CURRANT STEM GIRDLER AND CURRANT BORER

E.F. TASCHENBERG, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00516)

OBJECTIVE: Obtain details of life history and seasonal development of both insects and develop practical chemical control measures for both.

APPROACH: Surveys will be made to determine abundance and extent of damage caused by the pests. Observations are to be made on seasonal development and life history of both insects under field conditions. Studies on some stages of development will be made in the laboratory under controlled conditions. Studies to be made on control will involve evaluating insecticides and determining harvest residues on fruit treated with the more effective materials.

PROGRESS: The limited work on the currant borer was aimed at developing a suitable method for collecting eggs in the lab. Records on hatch of eggs collected in the lab in February & June showed considerable variation. The hatch of eggs deposited by moths emerging in June was about the same as for eggs deposited in the field. The indication is that forcing larvae collected in the field in January to maturity and emergence of adults in Feb. effect fertility of eggs even though mating appears to be normal. Life history studies on currant stem girdler were carried on as in other years. Records were obtained on larval mortality, survival & parasitism, & the various species of parasites are being identified. Histological studies on the male abdomen failed to reveal the presence of a gland which was believed to produce a compound acting as a stimulant to females prior to mating. It is planned to continue this study to locate the gland in question. Males in early stages of pupal development were collected & slides were prepared from this material for the purpose of establishing karyotype of the species. The studies of slide preparations are incomplete. Studies were made for the purpose of comparing courtship & mating behavior of the stem girdler & Cephus pygmaeous. Since additional observations are needed this work will be continued in 1970.

SUPPORTED BY New York State Government - Albany

4.0417, BIOLOGY AND CONTROL OF GRAPE BERRY MOTH

E.F. TASCHENBERG, New York State Agric. Sta., *Geneva, New York* 14456 (NYG00521)

OBJECTIVE: Develop an economical spray program for controlling the pest without residues in excess of legal tolerances. Obtain information on life history.

APPROACH: Field tests to evaluate experimental insecticides. Use various supplements added for the purpose of spreading and sticking. Deposit analyses will be made to determine whether the alkaline fungicide mixture used on grapes effects the more promising insecticides. Residue analyses to establish decline curves.

PROGRESS: The grape berry moth population continued to be rather low in many vineyards. A control experiment was conducted in one vineyard where injury was rather light, 12.9% of the berries injured in the check plots. Three applications of Guthion at the 0.5-100 rate was the standard treatment. In general there were relatively small differences in the performance of these materials, Hercules 14503, Ciba 9491, Azodrin, and Geigy 13005, all performed as well as Guthion. Zolone at the 1.5-100 rate was less effective than the other materials. Gardona and Stauffer's insecticide N 2596 gave promising results. Studies on the disappearance of insecticides on grape berries were continued. Samples were collected from treatments of 8 experimental insecticides. When 2 rates of some materials were used samples of fruit treated with the lower rate were collected at weekly intervals over a 35 day period. For higher rates samples were collected at 14, 28 and 35 days after the final treatment was applied. On each sampling date four 200 gram lots of berries were picked for each treatment. The analyses on these samples are imcomplete. No attempt was made to work on the problem of sampling grapes for use in determining amounts of spray deposits and harvest residue.

SUPPORTED BY New York State Government - Albany

4.0418, CHEMICAL WEED CONTROL IN FLORIST AND NURSERY CROPS

A. BING, State University of New York, Agricultural Experiment Sta., *Ithaca, New York* 14850 (NYC00653)

OBJECTIVE: Find out about how herbicides work and develop recommendations for their use in nursery and florist crop production.

APPROACH: Herbicides (particularly Zytron) of proven ability to control crabgrass and other annual grasses and weeds will be applied at rates including those recommended by the manufacturer and shown to be appropriate in field trials with vegetable crops, applications to be made to woody ornamentals in dormant condition for control of winter annual weeds for fall and early spring control. Selected herbicides are to be applied in granular formulation or directed spray for control of seedling weeds following spring clean up and early growth of ornamental plants, and are to be applied to such perennial weeds as quack grass during the first flush of weed growth in spring.

PROGRESS: In new nursery plantings, preplant applications of trifluralin and diphenamid gave good temporary weed control but required cultivation or additional herbicide applications to be adequate for the growing season. Postplant treatments of simazine 4-6 lb aia were the only really effective ones. Simazine at 6 lb aia discolored older Forsythia foliage but Forsythia and Ligustrum plants grew well. December applications of dichlobenil were very effective for weed control in 1 year old stock. Surface applications of dichlobenil did not control field bindweed (Convolvulus arvensis). Wetting agents are being applied to bindweed and Artemesia infestations before adding dichlobenil to see if this improves control. Diphenamid followed by several cultivations was every effective. Incorporated diphenamid 4 lb aia followed by simazine 1 lb aia in the spring was quite effective and safe on peonies. The application was repeated during the growing season. Planavin drenched into the soil following of flowering size gladiolus corms was superior to mechanical incorporation and equal to soil incorporated trifluralin. With a late planting, the one treatment was adequate for the season. Preplant applications of trifluralin and postplant applications of trifluralin and diphenamid were fairly effective and safe for azalea liners in a soil rich in peat moss.

SUPPORTED BY New York State Government - Albany

4.0419, WEED CONTROL IN PASTURES AND FORAGE CROPS

D.L. LINSCOTT, State University of New York, U.S.D.A. Crops Research Div., *Ithaca, New York* 14850 (0710-04-09)

OBJECTIVE: Develop methods of weed control in pasture and forage crops which will result in minimal chemical residues. Adapt and develop methods and procedures for herbicide, metabolite and degradation product analysis in pasture and forage crops. Determine affects of environment and stage of growth of plants on degradation of herbicides applied to forage and pasture crops.

APPROACH: Conduct field and greenhouse investigations to determine effective herbicides for controlling weeds. Analyze forages and soils to determine persistence and degradation of herbicides. Develop new and adapt old methods of analysis for each herbicide and for each particular weed or crop. Impose herbicide rate and environmental variables and measure the persistence of herbicides in various forage and weed plants.

PROGRESS: 3-(2,4-dichlorophenoxy)propionic acid 3-(2,4-DP) was recovered from bromegrass, timothy and orchardgrass after 2,4-D application. This metabolite of 2,4-D was isolated by gas chromatography and identified by mass spectroscopy. Up to 70 ppm of 3- (2,4-DP) was found in bromegrass and 20 ppm in timothy and orchardgrass which indicated that it is a major metabolite of 2,4-D. Conversion by grass of 2,4-D to the herbicidally inactive 3-(2,4-DP) may be a primary mechanism of resistance of grasses. When ester derivatives of 2,4-D, 2,4-DB, 4-(2,4-dichlorophenoxy)crotonic acid and 4-(2,4-dichlorophenoxy- beta-hydroxy)butyric acid were applied to alfalfa, 2-carbon additions to the aliphatic chains resulted. Residues from dalapon applied to seedling alfalfa or stubble were reduced from 55 to 85% during chopping and dehydration at harvest. Persistence of dicamba applied to timothy at 0, 1/4, 1/2, 1, and 2 lb/A was determined. Four weeks after treatment residual concentrations of dicamba were 0, 0.1, 0.2, and 2 ppm respectively. Crownvetch was brought to the flowering stage in the seedling year by controlling weeds with preplanting (incorporated) applications of EPTC or benefin, followed by simazine or bromacil applications between the seeded rows.

SUPPORTED BY U.S. Dept. of Agriculture

4.0420, HERBICIDES FOR VEGETABLES

R.D. SWEET, State University of New York, Agricultural Experiment Sta., *Ithaca, New York* 14850 (NYC00757)

OBJECTIVE: Study experimental herbicides developed by chemical companies.

APPROACH: Chemicals will be evaluated under field conditions to determine the crops on which they will be selective; also weed species which they will control. Experiments will be designed so that the influence of the soil, rainfall, timing and dosage on activity and safety will be determined. The tests will provide the basis for 'directions for use'.

PROGRESS: Linuron post-emergence in carrots usually kills weed species missed by stoddard solvent. However, yield reductions sometimes occur. Extensive field and greenhouse tests show damage is dependent on crop variety. Danvers 126 and Red Core Chantenay are fairly tolerant whereas Nantes and many fresh market varieties are susceptible. Nitrofen used post-emergence on cabbage, carrots, and onions sometimes causes foliage burn. Greenhouse and field tests show the wettable powder formulation is much less toxic than the emulsifiable concentrate. An experimental herbicide, Monsanto 49814, is the only post-emergence selective yet introduced for cucumbers. Erratic crop response has been noted here and elsewhere. Current research results show that varieties vary in their tolerance. Generally, blood lines resistant to mosaic and scale show less tolerance than those resistant to mildew. At present, this is only a correlation and no study has been made to determine if any causal relationship exists.

SUPPORTED BY New York State Government - Albany

4.0421, DEVELOPMENT OF ANALYTICAL METHODOLOGY

L. FISHBEIN, U.S. Dept. of Hlth. Ed. & Wel., P.H.S. Natl. Insts. of Health, *Durham, North Carolina* 27709

The development of analytical methodology programs in progress include (a) the spectrochemical and GLC determination of nitrite- nitrate and miscellaneous nitrogen derivatives in baby foods; (b) TLC and GLC determination of urinary metabolites of methylenedioxyphenyl synergists; (c) GLC analysis of chlorodibenzodioxins in polychlorophenols and chlorophenyoxy acids; (d) GLC determination of metabolites of paradichlorobenzene; (e) TLC and GLC determination of N-hydroxy and related derivatives and metabolites of food additives and (f) TLC and GLC determination of the prostaglandins and related derivatives.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0422, THE DEGRADATION OF DDT, TDE, AND DIELDRIN IN THE CIGARETTE MAIN-STREAM AND SIDE-STREAM SMOKES

N.M. CHOPRA, Univ. of North Carolina, School of Arts, *Greensboro, North Carolina* 27412

DDT, TDE, and dieldrin were extensively used as pesticides on tobacco plants until very recently, and for quite some time cigarettes available in the market would carry these pesticides and their degradation products. Little work has so far been done on the (1) fate of these pesticides and their degradation products in cigarette smokes, (2) the mechanisms of the degradation of pesticides in tobacco smokes, and (3) the possible hazards these pesticides and their breakdown products may cause to the smoker. We are here working on these topics. Recently we sent a paper entitled: 'Systematic Studies on the Breakdown of p,p'-DDT in Tobacco Smokes'.

Research Methodology.- The research consists of 4 phases: 1. Study on the pyrolysis of pesticides and isolation and identification of their breakdown products. 2. The identification and estimation of the breakdown products of the pesticides in tobacco smokes. 3. Study on the pyrolysis of pesticides in cigarette mainstream and side-stream smokes. 4. After the nature and amount of pesticides and their breakdown products are determined in cigarette smokes, samples may be sent to suitable laboratories for the evaluation of the possibility of their hazard to the smoker.

SUPPORTED BY Council for Tobacco Res. - New York, N.Y.

4.0423, REDUCTION OR ELIMINATION OF PESTICIDE RESIDUES ON FOOD AND FEED PRODUCTS

L.W. AURAND, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC00032)

OBJECTIVE: Study food and feed products with respect to the location and persistence of pesticide residues in market products; effects of pesticide residues on quality characteristics; and the development of commercial marketing and processing techniques for the detection, removal and/or neutralization of pesticide residue effects. Estimate costs of alternative techniques for the commercial reduction of pesticide residues in food and feed products.

APPROACH: Clean-up techniques will be examined using milk samples containing known amounts of pesticides (DDT, lindane, methoxychlor and endrin). Attention will be given to the specificity of the extraction techniques. Modifications will be developed with the objective of improving techniques to be used in routine quality control. Milk will be subjected to heat, vacuum, steam distillation, various chemical and physical treatments to remove or neutralize the residues present.

PROGRESS: The distribution of DDT and its metabolites in porcine tissues was investigated by feeding 4 levels (0, 20, 40, 80 ppm) to pigs for 10 weeks. Results showed that there was a significant difference between tissues within the animal, indicating that concentration of DDT was not solely dependent upon fat concentration of the tissue. Too, results showed the pig is capable of metabolizing DDT to its less toxic analogs and a major portion of this metabolism occurs in the liver.

SUPPORTED BY U.S. Dept. of Agriculture

4.0424, REDUCTION OR ELIMINATION IN COMMERCIAL CHANNELS OF PESTICIDE RESIDUES IN FOODS

L.W. AURAND, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC02052)

OBJECTIVE: Study foods and food products in market channels with respect to: Use and development of commercial handling and/or processing techniques for the removal or reduction of insecticide residues in meat, fruits and vegetables; Specific location of insecticides on or within plant tissues, plant products and seafoods; Effects of pesticide residues on quality characteristics of the above foods. Evaluate available market alternatives following various processing techniques which reduce insecticide residue levels.

APPROACH: Food samples with known histories of production and pesticide application will be subjected to various food processing treatments. Residues and product quality (flavor, appearance, texture, etc.) will be determined using currently accepted methods. These findings will then be used for studying food residues in/on foods in the various market channels.

PROGRESS: Scuppernong grapes (variety 20-119) were subjected to a spray schedule including maneb and benomyl, the grapes have been collected, and are now in storage. Methodology for above two pesticides has been standardized so that we are now in a position to begin an analytical study of the disappearance of the residues from time of harvest to the finished product.

SUPPORTED BY U.S. Dept. of Agriculture

4.0425, CONTROL OF ARTHROPOD PESTS OF COTTON

J.R. BRADLEY, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC03011)

OBJECTIVE: Determine relative toxicity of pesticides to select arthropods, selective timing of pesticide applications, status of insecticide resistance in Heliothis spp., extent of phytotoxic interactions among pesticides.

APPROACH: Chemical and microbial pesticides will be evaluated in the field and laboratory for effects on arthropods associated with cotton fields. Selectivity in the timing of pesticide applications will be established in field studies. The extent and importance of phytotoxic interactions resulting from pesticide combinations in soil will be studied in the field and laboratory.

PROGRESS: Insecticide screening tests designed to find suitable replacements for DDT for control of cotton insect pests, combinations of toxaphene plus methyl parathion gave desired performance. Studies on timing of pesticide applications revealed that insecticide applications made prior to fruiting of cotton plants do not increase yield while adding to production costs. Commercial formulations of a nuclear polyhedrosis virus were found to be effective in controlling bollworms. Persistence studies indicated that virus formulations are rendered ineffective through photo decomposition within 3 days. Laboratory studies of insecticide resistance in Heliothis spp. showed North Carolina strains of the tobacco budworm to be higly resistant to DDT and TDE, moderately resistant to toxaphene-DDT and susceptible to methyl parathion. In pesticide interaction studies methyl parathion was found to cause a significant delay in maturity and decrease in yield when applied prior to fruiting of cotton plants.

SUPPORTED BY U.S. Dept. of Agriculture

4.0426, IMPROVED CONTROL OF APPLE DISEASES UNDER NORTH CAROLINA CONDITIONS

C.N. CLAYTON, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC03031)

OBJECTIVE: New fungicides in apple spray programs for improved disease control under N.C. conditions, relative susceptibility of apple rootstocks to root-rot fungi, fire blight control with post-bloom streptomycin sprays, causes and incidence of any new apple diseases.

APPROACH: New fungicides evaluated for disease control and phytotoxicity. Rootstocks tested for susceptibility to root rot fungi. Streptomycin in post-bloom sprays for fire blight control will be tested. New disease problems will be surveyed.

PROGRESS: Scab was very damaging in orchards where the first fungicidal spray was delayed or omitted. Quince rust (Gymnosporangium clavipes) infected many Red Delicious fruits early in the season before a fungicide was applied. Southern stem blight (Sclerotium rolfsii) killed up to 20% of trees in a few Piedmont orchards. An unusually severe epidemic of bitter rot (Glomerella cingulata) affected apples at the Sandhills Research Station. By harvest or 1 month after the last spray, 60% of non-sprayed Golden Delicious fruits had bitter rot. Fruits sprayed 9 times after bloom with Benlate 50W, 1/2 lb. per 100 gallons were 61% affected. Fruits sprayed with Captan 50WP 2 lb. averaged 75% bitter rot. Thynon 75W 1 lb. reduced bitter rot to 18% and Maneb or Dikar at 2 lb. reduced it to 8 and 11%, respectively. All fungicides controlled sooty blotch 100%. Benlate appeared very promising or equal to Folpet against Botryosphaeria rot. Maneb was the most effective fungicide against the necrotic leaf blotch of Golden Delicious. Fire blight was markedly reduced 90% or more by 4 streptomycin (100 ppm) sprays during and 1 week after bloom. A heavy Difolatan and oil spray in the 1/4 - 1/2' green stage resulted in much injury to the fruit finish of Red Delicious, Golden Delicious and Stayman cultivars. Oil applied in the 1/2' green stage and followed by Captan within two weeks resulted in severe foliage injury.

SUPPORTED BY U.S. Dept. of Agriculture

4.0427, PESTICIDE INTERACTIONS - INFLUENCE ON PLANT GROWTH AND MECHANISMS OF TOXICITY AND DETOXICATION

F.T. CORBIN, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC03264)

OBJECTIVE: Determine the presence and effects of pesticide interactions on selected plant species; evaluate the influence of molecular structure, pH, ionic species and temperature on chemical interactions; investigate mechanisms of interaction.

APPROACH: Growth response curves will be established for pesticides alone and in binary combination with other pesticides under field and controlled environmental conditions. The mechanisms by which phytotoxicity is altered by combinations of organic chemicals will involve the use of C-labelled pesticides. Regulatory roles of the following groups will be studied in detail: Antagonism of carbamate herbicides by phosphate insecticides, antagonism of S-triazine herbicides by a diazo fungicide, and synergism of urea herbicides by phosphate insecticides. From evaluations of pesticide uptake, translocation, metabolism and detoxication, postulate mechanisms of interaction.

PROGRESS: The response of cotton to combinations of diuron 3-(3,4- dichlorophenyl)-1,1-dimethylurea , trifluralin (alpha,alpha,alpha- trifluromethyl-2,6-dinitro-p-toluidine), fluometuron 1,1-dimethyl-3- (alpha,alpha,alpha-trifluoro-m-tolyl) urea , or nitralin 4- (methylsulfonyl)-2,6-dinitro-N,N-dipropylaniline with phorate o,o- diethyl-S-(ethylthio methylphosphorodithioate and disulfoton o,o- diethyl-S-2-(ethylthio) ethylphosphorodithioate was determined under two controlled temperature conditions. Combinations of the herbicides with phorate and disulfoton were more toxic to seedling cotton at a low temperature. Field experiments were conducted at two locations to evaluate the response of cotton to combinations of trifluralin or fluometuron with phorate, disulfoton, methyl parathion (o,o-dimethyl-o- p-nitrophenyl-phosphorothioate), azodrin (3-hydroxy-N-methyl- ciscrotonamide dimethyl phosphate), and temik 2-methyl-2-(methylthio) propionaldehyde-O-(methylcarbamoyl) oxime . Foliar applications of insecticides which were initiated prior to square formation delayed maturity and reduced yields. Delay in maturity and yield reductions were also observed for seed furrow insecticide applications and for combinations of herbicides with insecticides at the most northerly location. The data will be important in determining the most efficient techniques for the application of pesticide mixtures to cotton.

SUPPORTED BY U.S. Dept. of Agriculture

4.0428, DISEASES OF CULTIVATED BLUEBERRIES IN NORTH CAROLINA

R. MILHOLLAND, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC05199)

OBJECTIVE: Develop effective control measures for stem canker (Botryosphaeria corticis), leaf spot (Gloesporium sp.), root rot (Phytophthora cinnamomi), and nematode diseases of blueberry; develop inoculation techniques with these organisms so that etiological and epidemiological studies can be made.

APPROACH: Seasonal development of blueberry diseases will be followed in grower plantings. Studies with stem canker fungus will include variation in pathogenicity with various isolates, development of inoculation techniques for use on young plants, and evaluation of fungicides for canker control. Species of Gloeosporium associated with a leaf spot will be identified. Determine varietal reaction to infection. Prevalence, disease development and control of Phytophthora root rot will be studied. Damage to blueberry plants by various species of nematodes will be determined. Control by soil fumigation and possible resistance will be attempted.

PROGRESS: Temperature was found to influence stem canker development on highbush blueberry. A resistant reaction was observed on Croatan plants inoculated with isolate 52 of Botryosphaeria corticis and held at 15 and 20C, while plants at

25C were susceptible 4 months after inoculation. Twenty-eight clones of 14 Vaccinium species were inoculated with a mixture of 6 races of B. corticis. Resistance to all six races was found in 16 of the clones. Results of histological studies with B. corticis indicated that enlargement of the stem canker is due to increased cell numbers, and not to increased cell size. The cortex and phloem were completely disorganized in susceptible blueberry stems, but no disorganization of these tissues was observed in resistant stems. Xylem invasion was associated with the proliferation of the cortical parenchyma into xylem rays. Blueberry cutting wood infected with the stem canker fungus can be successfully treated with BSM-11 (2500 ppm for 4 hr) without impairing the rooting of blueberry cuttings. The importance of leaf exudates in increasing the inoculum potential of Gloeosporium minus on blueberry leaves is suggested. Large brown, irregular shaped lesions 4-5 mm in diam. were produced on blueberry leaves inoculated with conidia suspended in guttation fluids exuded from the hydathodes. Inoculations with conidia suspended in distilled water resulted in small flecks.

SUPPORTED BY North Carolina State Government - Raleigh

4.0429, INSECTICIDAL CONTROL OF INSECTS ATTACKING FLUE-CURED AND BURLEY TOBACCO

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OBJECTIVE: Develop insecticidal control measures which are simple, effective, economical, and safe; mechanize insecticidal control of the tobacco budworm, and establish economic threshold for the tobacco budworm.

APPROACH: Determination of performance in control, phytotoxicity, tobacco flavor, insecticide residues, and side effects associated with use of carbamate, organophosphorus, organotin, organochlorine, bacteria, virus, and nematode preparations, selection of dosage rates, timing of applications, insecticidal formulations, additives, spray pressure and volume, and types of nozzles effective in tobacco budworm control when insecticidal treatments are applied mechanically, and measurement of the location, type, and amount of damage caused by various levels of tobacco budworm infestation under both caged and natural field conditions.

PROGRESS: In advanced test power sprays containing 1/2 lb/acre of Lannate (Reg.), Azodrin (Reg.), or Durban (Reg.), or 1 lb/acre of Supracide (Reg.) continued to show significant promise for control of the major leaf-feeding insects on tobacco. These experimental organophosphorous and carbamate insecticides were more effective (90 vs. 50% control) against the tobacco budworm than were the insecticides in recent use (DDT, TDE) or current use (carbaryl, endosulfan). These new materials were also highly effective against the tobacco flea beetle and the tobacco hornworm. Thus, these new insecticides offer the promise of more effective control at lower cost and with less insecticidal contamination of tobacco products and the general environment. In preliminary tests 1 lb/acre of Monitor (Reg.) showed significant promise for control of budworms and flea beetles.

SUPPORTED BY U.S. Dept. of Agriculture

4.0430, PHYSIOLOGICAL MECHANISMS INVOLVED IN SELECTIVE PHYTOTOXIC ACTION OF HERBICIDES

D.E. MORELAND, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC03122)

OBJECTIVE: Determine the effects of herbicides on physiological processes of plants, and the physiological basis for the selective control of plant growth by herbicides.

APPROACH: Effects of representative herbicides will be studied on various enzyme systems and organelles isolated from plants. Processes to be studied will include photosynthesis, respiration, nucleic acid metabolism, and protein synthesis. The same system will be isolated from different species and varieties of plants to identify differential responses which might explain the selective action of herbicides.

PROGRESS: 3,5-dibromo-4-hydroxybenzaldehyde O-(2,4-dinitrophenyl)oxime (C-9122) and bromoxynil uncouple oxidative phosphorylation in potato tuber mitochondria. The uncoupling action resembles that of DNP, but responses are produced at much lower molar concentrations. C-9122 is also a very strong inhibitor of mitochondrial electron transport. In addition, C-9122 and bromoxynil affect chloroplast photoreactions by inhibiting electron transport at or near photosystem II. C-9122 has a second site of action associated with the ATP generation pathway of chloroplasts. Diphenylether herbicides such as nitrofen also inhibit electron transport in both mitochondria and chloroplasts. Herbicides which interfere with the generation of ATP in isolated mitochondria were shown to strongly depress ATP levels in excised soybean hypocotyl tissue at molar concentrations that also inhibited RNA and protein synthesis. The biosynthetic reactions and physiological processes which constitute growth require energy supplied by ATP. Hence, interference with ATP generation may be a major mechanism through which the phytotoxic action of many herbicides is expressed.

SUPPORTED BY U.S. Dept. of Agriculture

4.0431, CONTROL OF TOBACCO DISEASES BY SOIL FUMIGATION

C.J. NUSBAUM, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC03033)

OBJECTIVE: Identify and evaluate soil treatment chemicals for tobacco disease control, effects on pathogen populations, relations between pathogen densities and crop response, and effects on leaf quality, usability.

APPROACH: Identify promising materials and procedures in preliminary tests and evaluate them in advanced, standardized field tests. Take data on stands, growth response, phytotoxicity, seasonal disease development, pathogen populations, disease intensity and crop yield and quality. Correlate pathogen populations differentiated by chemicals with crop yields. Analyze cured leaf samples for quality and possibly health related constituents, chemical residues, smoke taste.

PROGRESS: Preplant soil treatments with broad spectrum biocides, Vorlex (chlorinated C(3) hydro-carbons 80% - methyl isothiocyanate 20%), Telone C (dichloropropene 85% - chloropicrin 15%), and Terr-O-Cide 15 (ethylene dibromide 40% - chloropicrin 15% - inert 45%) reduced losses from root knot, black shank, southern bacterial wilt and black root rot and increased tobacco crop values 250 to 500 dollars per acre. Control of black shank and wilt was effective only with resistant varieties. Telone C and Terr-O-Cide 15, available for commercial use on tobacco for first time in 1970, were more effective against wilt than Vorlex. Several other formulations containing chloropicrin, initially tested in 1969, showed promise. In fields heavily infested with root-knot nematodes, fumigant nematicides gave better control than nonfumigant types such as Mocap (S,S dipropyl O-ethyl phosphorodithioate) and Dasanit (O,O-diethyl O-p (methylsulfinyl) phenyl phosphorothioate). Chemical analysis of samples from 1968 tests showed that tobacco from nontreated plots had halogen contents of 0.4 to 0.6% compared with 0.6 to 0.8% for samples treated with halogen containing fumigants. Values less than 1.0% do not affect leaf combustability adversely. Samples from recent experiments have been made into cigarettes for smoke analysis.

SUPPORTED BY U.S. Dept. of Agriculture

4.0432, BEHAVIOR OF SPECIFIC HERBICIDES IN PLANTS AND SOILS

J.B. WEBER, Univ. of North Carolina, Agricultural Experiment Sta., *Raleigh, North Carolina* 27600 (NC01018)

OBJECTIVE: Determine the effects of climatic and edaphic factors on movement, persistence, and toxicity of herbicides in the soil, investigate the adsorption, translocation, accumulation and degradation of herbicides in plants and determine the effects of herbicides on anatomical and morphological responses, seed germination and growth and selected metabolic systems.

APPROACH: Two herbicides from diverse chemical families will be used. Leaching studies employing soil columns of several soil types of the S.E. United States and bioassay chemical analyses to determine the movement of the herbicides will be performed. The effects of factors such as soil moisture, temperature, pH and soil constituents on herbicide disappearance will be studied in laboratory and greenhouse experiments. Radioisotope samples of

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the two herbicides will be used in determining their absorption, translocation, and accumulation by plants, and in determining their degradability by soil microbes.

PROGRESS: The project completed the third year in a cooperative bioassay study with other state experiment stations involving soil- applied prometryne. The results are presently being prepared for publication and should be very useful in helping to standardize bioassay techniques. Six chapters were prepared for the S-18 laboratory manual and when completed this book will serve as an excellent reference for methods and techniques used in weed research. Adsorption studies showed that cotoran and seven related phenylureas were adsorbed by ethylcellulose, exchange resins and soils in accordance with their molecular size; the larger compounds were adsorbed in the greater amounts. Indications are that the adsorption arises from hydrogen bonding or other dipolar forces. Prometryne and fifteen related S- triazines were adsorbed by soil constituents through ionic and dipolar adsorption forces. Growth chamber studies showed that the adsorbed herbicides were less available for use by growing plants. Field experiments carried out on soils modified with the incorporation of clay minerals, muck, gypsum, and limestone yielded results in agreement with those of the laboratory and growth chamber. These studies will lead to a better understanding of the behavior of herbicides in plants and soils. Principles which are developed will be of value in solving problems of herbicide effectiveness and herbicide residue.

SUPPORTED BY U.S. Dept. of Agriculture

4.0433, BIOLOGY, ECOLOGY AND CONTROL OF INSECTS IN SHELTERBELTS AND NURSERIES IN THE GREAT PLAINS

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OBJECTIVE: Inventory and assess damages of tree insects in the Great Plains; study the more damaging ones in sufficient detail to develop controls; prescribe or develop controls.

APPROACH: The identity of tree insects and damages they cause will be determined from field surveys and economic analyses. The more important insects will then be studied through the following steps: distribution, abundance and impact on woody plants; life history and habits; influence of climate, predators, and host conditions; methods of control.

PROGRESS: Trees and shrubs in protective tree plantings on the Great Plains are hosts for many insects; the roles of insects in shelterbelt ecology are generally unknown. New research was initiated to develop methods of detecting, evaluating, and controlling insects with potential for damage. The red elm bark weevil was found to be an important pest of American elm planted extensively in windbreaks. Injured trees or trees of low vigor in shelterbelts in poor condition are most likely to be attacked. Bark beetles, Lesperisinus sp., are significant pests of green ash, one of the most valuable trees planted. L. californicus infestations seem to develop in living branches of trees under stress and eventually girdle the main stem and kill the tree. L. criddlei is a secondary beetle and follows californicus in dying tissue. The systemic insecticide oxydemetonmethyl was more effective than dimethoate, which was phytotoxic, and malathion for protection of American elm from woolly elm aphid. Phorate and carbofuran were superior to dimethoate for protection of ponderosa pine nursery stock from damage by pine tip moth; all three materials were significantly better than oxydemetonmethyl or DDT.

SUPPORTED BY U.S. Dept. of Agriculture

4.0434, BIONOMICS OF THE CEREAL LEAF BEETLE

J.R. DOGGER, North Dakota State University, Agricultural Experiment Sta., *Fargo, North Dakota* 58103 (ND-H-05-014)

OBJECTIVE: Determine distribution and factors responsible for dispersal. Determine means of control.

APPROACH: Surveillance maintained for the appearance of the cereal leaf beetle in areas not now infested. Grain varieties and selections furnished by plant breeders will be evaluated in the field. Lines showing tolerance or resistance studied to determine nature of resistance and manner of inheritance. Systemic insecticides will be screened for phytotoxic effects on small grains.

PROGRESS: Research was directed toward developing means of controlling cereal leaf beetle if it should reach North Dakota. Plant resistance was investigated by submitting breeding material from area to Michigan where evaluation was made by cooperators in field. Chemical control could not be tested in North Dakota. Systemic materials, which would appear to have minimal effects on natural enemies, were evaluated as to phytotoxicity and effectiveness against other insect pests. Several hard red spring wheat varieties, in use in North Dakota, showed apparent resistance in field tests. These included Selkirck and Lee. Two breeding lines tested in 1966 showed no oviposition or feeding while others showed either minor feeding or lack of oviposition. Durum varieties from North Dakota showed heavy feeding, but progress has been made in cooperative work with agronomists in obtaining lines with some degree of resistance. Barley varieties in use in the area were subject to heavy feeding. Very few lines tested have shown apparent resistance. All North Dakota wheat varieties showed heavy larval feeding, but many lines tested in the region exhibited apparent resistance. Furadan showed promise in aphid control and low phytotoxicity in North Dakota and is effective against cereal leaf beetle in Wisconsin as a systemic. Baygon, used effectively as seed treatment in Michigan, was not phytotoxic used in this manner in North Dakota. Other promising materials for use on North Dakota grain from standpoint of phytotoxicity and aphid control are Temik and Thimet.

SUPPORTED BY U.S. Dept. of Agriculture

4.0435, FACTORS INFLUENCING INSECTICIDE RESIDUES IN FOOD, FORAGE AND OIL CROPS, AND SOIL

M.S. QURAISHI, North Dakota State University, Agricultural Experiment Sta., *Fargo, North Dakota* 58103 (ND-H-05-016)

OBJECTIVE: Determine factors influencing magnitude, and persistance of insecticide residues occurring in food, forage and oil crops. Determine rate for the disappearance of commonly used insecticides from soil types. Determine magnitude of movement of selected insecticides and role as possible contaminants of water sources.

APPROACH: Magnitude of residues of selected insecticides and metabolites ascertained on potatoes, sugarbeets, oil crops, grassland range and soil, chemical and biological methods. Factors influencing magnitude and degradation of residues will be ascertained. Identification of metabolites will be made and analytical techniques will be modified or developed.

PROGRESS: Work with Temik residues has been continuing, and degradation of Temik in soil under laboratory conditions and in the field has been studied. Leaching of Temik by water from treated soil and its persistence in water have also been investigated. The insecticide degrades readily in soil at temperatures between 27-34 C. in 8-10 weeks. It can be easily leached from soil by water, and is more persistent in water, though sunlight accelerates its break down. Potatoes and sugar beets treated with Temik according to recommendations were not found to contain detectable residues at the time of harvest. Volatilization of chlorinated hydrocarbon insecticides from treated surfaces, and its contribution to environmental pollution was studied. Small amounts of 2,4-D esters are used for improving the color of potatoes in the Valley. Residues of PGBE ester were determined in treated potatoes in cooperation with Dr. Nelson (project H-12-14). Potatoes treated at 2 and 4 oz. per acre yielded negligible residues. Residues of DDT were determined in samples of soil collected from areas treated for Mosquito Control. Most of the samples contained residues in the range of 4-30 ppm. Two samples contained approximately 1000 ppm. Further investigations are in progress. An interesting aspect is the finding of DDD in these samples. Evidently biochemical and chemical reactions favor conversion of DDT to DDE as well as to DDD.

SUPPORTED BY U.S. Dept. of Agriculture

4.0436, PHYSIOLOGY OF ACCUMULATION AND PERSISTENCE OF PESTICIDES IN PLANTS

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OBJECTIVE: Determine effects of environment, growth and physiological status on pesticide disposition by plants. Determine effect of controlled environment on translocation, accumulation, loss and alteration of pesticides and their metabolic products in plants.

APPROACH: Study the influence of environmental variables such as shoot and root temperature, water balance, light regime, nutrition and stage of growth on pesticide disposition by plants. Determine effects of environmental pollutants on pesticide disposition by plants. Study occurrence of pesticides and pesticide metabolites in selected plant tissues as influenced by the factors indicated above and by the method, rate, and duration of pesticide treatment.

PROGRESS: Hydrolysis of propanil supplied to rice via the roots was determined by colorimetric quantitation of propanil, 3,4- dichloroaniline and its glucoside extracted from rice seedlings supplied with 20 ppm propanil alone or in combination with 10 ppm sodium fluoride in the nutrient solution. Results indicated that propanil is metabolized in rice to the aniline and the glucoside in the presence of this level of NaF. Manipulation of plant age, pretreatment with NaF, and alteration of calcium supply did not consistently alter the extent of metabolism of propanil in rice. Fumigation of rice with ozone at levels producing incipient visible injury did not reduce the capacity of excised rice leaves to metabolize propanil to the aniline and glucoside. Subsequent metabolism of the glucoside to insoluble products may have been impaired. Intact corn plants were fumigated with ozone to produce incipient visible injury, after which excised leaves were allowed to absorb and metabolize as much dealkylated atrazine as did controls. Other pathways were not inhibited. Inhibition of dealkylation appeared to be greatest in plants fumigated late in the day. Other effects of ozone on metabolism of selected herbicides are being studied.

SUPPORTED BY U.S. Dept. of Agriculture

4.0437, EFFECT OF HERBICIDES ON FOOD CROPS

E.K. ALBAN, Ohio State University, Agricultural Experiment Sta., *Columbus, Ohio* 43210 (OHO00142-SS)

OBJECTIVE: Determine if 1X and 2X applications of approved herbicides affect the qualitative and quantitative yields of potatoes and tomatoes; if special handling of the raw and processed product can be utilized to minimize possible adverse effect of the herbicide used.

APPROACH: Utilize the best objective qualitative analyses of the raw product and processed tomato and potato, as related to possible herbicide effects. Utilize radio-active isotope procedures in evaluating persistence of herbicides in the raw product and processed item, i.e., potato and tomato. More clearly ascertain effects of herbicides and quality of tomatoes and potatoes as fresh vegetables; also determine role of processing in this area.

PROGRESS: Tomatoes were treated with two rates of Dymid, Vegiben, and Dacthal and potatoes were treated with two rates of Eptam and Dinitro herbicides. Differences between rates of application and among herbicides as to effects on yield, quality and weed control were negligible. Differences were obtained between treatments and the control in terms of yield for tomatoes but not for potatoes. However, the control of weeds was significantly better for the treatments in terms of harvesting procedures, pesticide applications, and weed control. During the three years of this study, the major differences have been among the years rather than between the treatments within a year or to beneficial effects of herbicides in terms of raw product, quality and weed control. The data showed that herbicides may be more beneficial in certain growing seasons as to production of higher quality, better weed control and greater yields. As to residues, there have been no detectable residues in the finished product, except for a residue of Dachtal at the 2X rate of application. Utilizing activation analysis in combination with gas chromatography, it was found that Dacthal was translocated throughout the plant while the other herbicides were apparently absorbed into the root but were not translocated into the other parts of the plant. Residues of Dacthal have been consistently found in tomato fruit during the three year period of this study.

SUPPORTED BY Ohio State Government

4.0438, WEED CONTROL STUDIES WITH HORTICULTURAL CROPS

E.K. ALBAN, Ohio State University, Agricultural Experiment Sta., *Columbus, Ohio* 43210 (OHO00071-2)

OBJECTIVE: Determine chemicals for weed control with regular cultural practices in horticultural crops; optimum time, rate, method of application and kind of chemical best suited for specific crops; and effect of herbicides on quality and yield of crops.

APPROACH: Herbicides included in this study are usually at least one to two years past the 'screening stage'. Data on rates/A, weed species controlled, and indication of crop tolerance are ordinarily available. Quantitative and qualitative yields are obtained from randomized, replicated plots. Statistical analyses of crop yields and weed control data are made. Crop and weed response to herbicides as influenced by soil and environmental factors are determined under field and greenhouse conditions.

PROGRESS: Fall treatments using Paraquat, Casaron, and Simazine continue to provide excellent weed control in orchard plantings. Pre- plant bed treatments with Paraquat, Aminotriazole, Treflan, and Eptam in establishing new landscape plantings continue most promising. With sweet corn, there are an increasing number of herbicides, i.e. Sutan, preplant, Ramrod, Lasso, and combinations of Ramrod/Atrazine, Lorox/Atrazine. Eli Lilly's EL 179 looked most promising as a pre-plant incorporated herbicide with the following direct-seeded crops: cucumber, muskmelon, tomato, cabbage, cauliflower, broccoli, kale and turnip.

SUPPORTED BY U.S. Dept. of Agriculture

4.0439, PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSE OF PLANTS TO HERBICIDES

L.E. BENDIXEN, Ohio State University, Agricultural Experiment Sta., *Columbus, Ohio* 43210 (OHO00254)

OBJECTIVE: Study the developmental stages of the major weed species, and of major crop species as related to their tolerance of herbicides; the physiological responses of plants to herbicides under various environmental conditions; relate the effects of the environment during various developmental stages of plants to the course and fare of applied herbicides; and determine possible interactions between herbicides and native plant growth regulators.

APPROACH: An environment in which temperature, humidity, photoperiod, and light intensity and quality are controlled will be used to study the developmental stages of weed and crop species and to relate envirionment and stage of growth to phytotoxicity, course, and fate of applied herbicides.

PROGRESS: Studies on the physiology of tropic response in stolons of strawberry clover were continued. Erect curvatures in stolons were caused by ethylene and such ethylene-releasing compounds as 2- chloroethylphosphonic acid, GA(3), exclusion of O(2) from the atmosphere, exposure to far-red light preceeding the night (dark) period, exclusion of CO(2) from the atmosphere, DGMU, exposure to red light preceeding the night (dark) period, darkness, and low intensity light (below 580 ft-C) in order of increasing reaction times. It may be implied, due to the responses to light & DCMU, that phytochrome is involved in the tropic response of stolons. Morphactin IT 3233 was the only compound tested which completely prevented the GA(3)-induced upward curvature of stolons. Ethylene evolutions of stolons subjected to darkness or GA(3) which induced curvature was comparable to the control plants. IAA increased and 2-chlorethylphosphonic acid greatly increased ethylene evolution. The study of nutsedge tuber sprouting was continued and anatomical and physiological studies of the plant as well as the tubers was initiated.

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SUPPORTED BY U.S. Dept. of Agriculture

4.0440, TRACE LEVELS OF PESTICIDE RESIDUES IN AGRICULTURAL COMMODITIES IN MARKETING CHANNELS

W.A. GOULD, Ohio State University, Agricultural Experiment Sta., *Columbus, Ohio* 43210 (OHO00303)

OBJECTIVE: Measure effects of pest fragments and pesticide residues on acceptability or nutritive value of agricultural commodities. Establish processing procedures for the removal, reduction or detoxication of pesticide residues and conversion products in agricultural commodities. Develop or improve methods for the determination of pesticide residues. Evaluate costs of removal and detoxification procedures for pesticide residues in food.

APPROACH: Emphasis will be upon using defoliants to control maturity of tomatoes and potatoes. Determine amount of chlorinated hydrocarbon that passes from egg to chick. Study of Loss of residues through processing different commodities will continue.

PROGRESS: During 1968 the defoliation work with tomatoes and potatoes was continued following similar application rates with sodium chlorate, Paraquate and sodium arsenate. Both commodities were harvested following specific days of field hold after defoliant applications and canned as whole tomatoes and juice or manufactured into potato chips. With tomatoes the only significant difference noted on canned tomatoes was a slight reduction in quality from the low rate (1/8 lb/A) of Paraquat treated lots. However all lots were of high grade (U.S. Grade A). With potatoes the sodium arsenate treated lots produced large size tubers, but no significant differences were obtained in specific gravity or quality of chips. No residues were found for any of the treated lots. The work was continued using similar defoliants and commodities and processing techniques in 1969.

SUPPORTED BY U.S. Dept. of Agriculture

4.0441, INTEGRATED CONTROL OF INSECT AND MITE PESTS OF APPLE ORCHARDS

R.P. HOLDSWORTH, Ohio State University, Agricultural Experiment Sta., *Columbus, Ohio* 43210 (OHOSS-153)

OBJECTIVE: Evaluate the relative effectiveness of insecticides that will reduce pest numbers without upset to beneficial arthropod populations. Identify the predators and parasites of apple pests, and determine their effectiveness in suppressing pest arthropods. Determine if a program of integrated control of apple insects in Ohio will reduce costs, lower insecticide use hazard, and circumvent resistance to insecticides. Ascertain the effects of integrated control programs on fruit quality and finish.

APPROACH: Set up and treat all trees in the orchard with integrated, preventive, and control schedules. Determine population levels of insect pests as well as their natural enemies. Make quantitative collections at regular intervals of apple pests and natural enemies in orchard, cover crop, and adjacent woods. Conduct orchard and laboratory studies of predation, and rear parasites from infested plots. Maintain records of insect control costs on a production unit basis, to record individual tree yields, to assess toxicity hazards, and to determine resistance if it occurs. Appropriate fruit samples will be taken at two selected harvest dates. These samples will be examined to determine effects on fruit finish and appropriate organoleptic and chemical determinations will be made.

PROGRESS: European red mite was controlled by naturally occurring predators for the 3rd successive year. Control of rosy aphids by natural enemies is variable and unreliable. Control of woolly aphids and apple aphids by natural enemies was not satisfactory. For the second year in succession, control of codling moth by lead arsenate in a modified schedule has been economically sound in the varieties Delicious, Golden Delicious and Rome Beauty, but damage in Jonathan was 3% (the economic threshold is 1.5%). This is progress, but a long term integrated program remains to be developed.

SUPPORTED BY Ohio State Government

4.0442, THE BIOLOGY AND CONTROL OF INSECTS AND MITES ATTACKING APPLES AND PEARS

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OBJECTIVE: Obtain information on the abundance, life history and ecology of insects and mites affecting apples and pears and to develop or improve safe, efficient and reliable methods of control. Devote special attention to the biology and control of the European red mite and codling moth.

APPROACH: Evaluate pesticides for phytotoxicity, compatibility, residues, and control of mites, codling moth, apple maggot, and aphids.

PROGRESS: Major emphasis was in developing acaricides for use against resistant European red mites. The best material applied in prebloom sprays was TH367, while azinphosmethyl was the least effective. Of the summer applied experimental acaricides, the best were Formetanate, Imidan, Bay 68138, Fundal and Acarol. Insecticides were tested for apple insects to give growers a choice of effective materials which are less hazardous to use. Rosy apple aphids were best controlled by TH3671 and endosulfan. Mevinphos, Carbofuran and Phosalone gave excellent control of apple aphids. Populations of codling moth and plum curculio were so low in apple orchards that no significant results were secured.

SUPPORTED BY Ohio State Government

4.0443, INFLUENCE OF PESTICIDE CHEMICALS ON THE APPLE

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OBJECTIVE: Study the influence of pesticide chemicals on: fruit, i.e., fruit-set, size, yield and quality. Foliage, i.e., mineral elements, chlorophyll photosynthesis and respiration. Study respiration pathways in apple tissue as related to susceptibility to injury from pesticides. Study factors affecting the uptake, translocation and breakdown of pesticides in apple tissue. Determine if changes in tree density and shape could result in reduced requirements for pesticides.

APPROACH: Various pesticide chemicals will be applied to bearing apple trees. Captan and DDT will be used as control chemicals to evaluate all other pesticides. Chemicals will be used as suggested by spray calendar recommendations. Standard spectrographic and manometric procedures will be used for mineral analysis and photosynthetic- respiration studies. Respiratory pathways responsible for hexose catabolism will be studied using glucose-1-C and glucose-6-C . C labeled pesticides will be applied to isolated fruit clusters.

PROGRESS: When excised leaf petioles were placed in C labeled DDT solution, C material moved through the vascular tissue into the leaves. The amount translocated was closely associated with transpiration rates. Labeled DDT placed on leaf surface was only slightly absorbed if at all. Exposure of C DDT treated leaves to several days of ultra-violet light resulted in a small change or breakdown of DDT on the leaf surface. Rate of absorption through the leaf and fruit surface in descending order was as follows: Alar, Carbaryl (Sevin), Dieldrin and DDT. Once absorbed, Alar and Carbaryl were readily translocated in leaves, stems, buds and fruit. DDT and Dieldrin were not translocated unless those materials were placed in the transpiration stream (cut leaves). 25 year old Jonathan Trees pruned heavily to the trapezoid shape produced less fruits, although pest control required only 1/2 normal rate of application of the pesticide. Thick trees (no pruning) required the normal amount. Fruit quality from all trees was satisfactory, although those from trapezoid trees the first year developed less red overcolor.

SUPPORTED BY U.S. Dept. of Agriculture

4.0444, BIOLOGY AND CONTROL OF VEGETABLE CROP INSECTS

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4. PESTICIDES

OBJECTIVE: Study the biology of insects attacking vegetable crops of major commercial importance and evaluate new chemicals with reference to increased efficiency in controlling insects and to greater safety to both the applicator and consumer.

APPROACH: The biology of the insect will be studied when it is considered essential to the development of control measures. Insecticides will be evaluated in controlling insects and/or mites when applied topically, to the soil, to the seed, and by various types of application equipment. The persistence of insecticides in the harvested crops and the soil will be determined.

PROGRESS: Experimental insecticides Galecron, Fundal, and Monitor gave outstanding control of the cabbage looper, treated plants averaging less than 0.25 looper larvae per plant compared with 48.0 on untreated plants. Next most effective material was Lannate which gave better control than other currently recommended insecticides. Amdal, a new strain of Bacillus thuringeinsis, was superior to all strains presently available. Monitor, Azodrin, and Furadan held green peach, turnip, and potato aphid populations to less than one aphid per leaf. Azodrin, Galecron, Fundal, Carzol, and Monitor gave excellent control of the two- spotted spider mite. All of these experimental materials were superior to those insecticides labeled for use by growers to control aphids and two-spotted mites. None of the newer experimental materials with soil systemic activity was superior to presently recommended Thimet and Di- Syston or to older experimental insecticides Furadan, Temik, and Lannate in the control of the potato leafhopper, potato flea beetle, and Mexican bean beetle.

SUPPORTED BY Ohio State Government

4.0445, DEVELOPMENT OF TILLAGE-REPLACING HERBICIDE SYSTEMS

G.B. TRIPLETT, Ohio Agric. Res. & Dev. Center, *Wooster, Ohio* 44691 (OHO00306)

OBJECTIVE: Develop herbicide systems for non-tilled crop production that control unwanted vegetation and minimize hazards: current crop, succeeding crops, of soil and water contamination.

APPROACH: Herbicides will be screened to determine their value in controlling unwanted vegetation and their hazard of crop injury. Promising materials and combinations of materials noted in screening trials will be evaluated for their adaptability to non-tilled crop production following sod and clean tilled crops. The best systems emerging from this research will be evaluated for contamination of crops, injury to following crops, contamination of surface water runoff.

PROGRESS: Atrazine at 3 to 4 pounds per acre is used to destroy perennial meadow grasses prior to planting corn. In a greenhouse study, pots containing oat plants were sprayed with several rates of atrazine alone and with oils and/or surfactants. Analysis of leaf tissue and soil showed that from 40 to 60 percent of the atrazine applied with oil was retained in the plant tops, a three- to five-fold increase over water alone or water plus surfactants. Even after the plant tops were dead, up to 20% of the atrazine recovered was in plant tops...Preliminary studies indicate atrazine present in plant tissue may not be as biologically active as the same amount in the soil. This would help explain the observed lower amount of carryover of atrazine applied to growing vegetation.

SUPPORTED BY U.S. Dept. of Agriculture

4.0446, GRAIN SORGHUM VARIETAL EXPERIMENTS

F.F. DAVIES, Okla. St. Univ., Agricultural Experiment Sta., *Stillwater, Oklahoma* 74075 (OKL00712)

OBJECTIVE: Determine the relative yield and adaptation of strains and varieties of grain sorghum when grown under comparable conditions of several locations within the State. Test new strains in nursery plants for possible adaptation.

APPROACH: Yields and observations will be taken from replicated test plots of commonly grown varieties, new varieties and strains of grain sorghum planted annually. A master nursery planting will be made at Perkins, Oklahoma annually with new strains included from any source. Data will be recorded on plant characteristics, drought tolerance and resistance, disease and insect resistance and preliminary productive capacity.

PROGRESS: 1. Mean grain yields for 90 hybrids (commercial, regional and state origin) at 7 dryland locations ranged from a low of 1629 lbs./A at Stratford (central area) to a high of 3258 lbs./A at Mangum (southwest area). 2. Midge and sorghum webworm caused significant grain losses at central and eastern locations. Midge damage was greatest in early types, while webworm losses were highest in late types. 3. An unusual, severe outbreak of a greenbug occurred in late July and extended through mid-August at all 9 test locations. At Goodwell (irrigated, narrow row, high plant populations and high nitrogen level), yields of the better hybrids were 4000 to 5000 lbs/A. This is 2000 to 3000 lbs./A below normal expectations. These yield reductions can be attributed in part to abnormally high temperatures during the greenbug infestation period, combined with varying degrees of foliage burning and flower sterilization from insecticides used in aerial spraying for greenbug control. Irrigated yields at Tipton were also below normal, with the better types below the 5000 lb./A level. 4. A dwarf, reddish-brown selection with a non-weathering seed factor, showed high potential as a winter feed grain for wildlife broodstock preservation. Sufficient seedstock are available for extensive testing of this line in 1969 for this special purpose use.

SUPPORTED BY Oklahoma State Government

4.0447, SWEET SORGHUM VARIETAL EXPERIMENTS

F.F. DAVIES, Okla. St. Univ., Agricultural Experiment Sta., *Stillwater, Oklahoma* 74075 (OKL00713)

OBJECTIVE: Determine the relative yield of forage seed and syrup of sweet sorghums when grown under comparable conditions.

APPROACH: 100 promising hybrids and new varieties of sweet sorghum will be planted and replicate tested throughout Oklahoma. Records will be made of the yields and chemical properties of the varieties.

PROGRESS: 1) At 6 dryland locations the higher yielding hybrids exceeded Sugar Drip (standard check variety) in dry matter production by 15 to 43 percent. Dry matter for the 16 entries at the 6 locations ranged from a low of 3.0 to 1.8 T/A at Woodward to a high of 7.5 to 4.1 at Muskogee. 2) Under irrigated conditions with close row spacing (18- inch), high plant population (80,000) per acre) and a high nitrogen level (200 lbs. N/A) the 16 entries ranged from 8.4 to 5.8 tons of oven dry forage per acre at Goodwell and from 9.5 to 4.3 at Tipton. 3) Yields were significantly reduced at Goodwell due to: abnormally high temperatures in early August, a severe infestation of greenbugs during the same period, foliage burn from insecticides used in greenbug control, and inclement weather which delayed harvest beyond the optimum stage of maturity. 4) In a winter grazing trial at Stillwater, cattle showed a preference and more complete utilization of the cured forage of Sugar Drip and a Tan Plant selection than for the forage of several forage hybrid types.

SUPPORTED BY Oklahoma State Government

4.0448, SUPPRESSION OF MYCOFLORA AND MYCOTOXINS IN NEWLY COMBINED, PARTIALLY CURED PEANUTS

K.H. GARREN, Okla. St. Univ., Agricultural Experiment Sta., *Stillwater, Oklahoma* 74075 (0620-02-29(G))

OBJECTIVE: To determine the effectiveness of fungitoxic gas for suppressing peanut mold fungi and mycotoxin contamination of high moisture peanut pods; and to determine the extent to which mold growth and mycotoxin production in newly-combined and partially cured peanuts can be suppressed in controlled atmosphere chambers.

APPROACH: High-moisture peanuts will be exposed to fungitoxic gases after inoculation with Asperigillus flavus, and mixtures of certain mold fungi. Survival or death of test fungi will be determined by phytopathological techniques. High-moisture peanuts previously inoculated with A. flavus will be held in anaerobic conditions (in nitrogen or carbon dioxide) at room and lower temperatures. Survival or death of A. flavus will be determined by microbiological and phytopathological techniques.

PROGRESS: No aflatoxin developed on high moisture peanut pods held in 100% N(2) or CO(2) atmosphere for 32 days at 37F. CO(2) was the better inhibitor of mold growth. Samples

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after storage had developed off-flavors, and those in nitrogen had a moldy odor. SO(2) was also used at 5% concentration. It caused off colors and poor flavors. Lower concentrations may be able to inhibit mold growth without causing unfavorable side effects. Flavor and odor of samples stored under high moisture conditions were not as good as those in conventionally dried samples. Aflatoxin developed in kernels of partially field-cured peanuts less readily than in freshly dug peanuts.

SUPPORTED BY U.S. Dept. of Agriculture

4.0449, THE DISEASES OF TURFGRASSES AND THEIR CONTROL

D.F. WADSWORTH, Okla. St. Univ., Agricultural Experiment Sta., *Stillwater, Oklahoma* 74075 (OKL01333)

OBJECTIVE: Fungicidal and phytotoxic properties of chemical materials for control of diseases of turfgrasses under Oklahoma environmental conditions. Causal agents of spring dead spot of bermuda grass. Relationship of disease development to thatch accumulation and decomposition. Effect of incipient or low level severity of disease development in turf in which active disease development appears to be arrested.

APPROACH: Field tests of chemicals will be made for the evaluation of disease control and phytotoxicity. Laboratory isolations will be made from diseased grasses to establish the pathogens involved and these isolates will be used for the development of artificial epidemics. Field and laboratory studies will be made on maintenance practices which produce an accumulation of thatch and the influence of thatch accumulation on disease development. Different concentrations of fungicides are to be used in a long range study to allow for different levels or severities of disease development. These severities are to be correlated with turf densities to determine if decreases in turf density are due to lack of complete disease control or phytotoxic accumulations of fungicides.

PROGRESS: Several turf plots were terminated and replanted with Penncross and promising new bentgrass strains, HCC7-2 and MCC-3. Limited tests were conducted with the fungicides Bromosan, TBZ and tank mix combinations of Koban in turf plots, Seaside, Penncross and C-7 bentgrass respectively. Koban provided excellent control of natural outbreaks of pythium blight alone or mixed in the tank with other fungicides. TBZ was very phytotoxic to bentgrass in several concentrations and was generally unsatisfactory in disease control. Bromosan was approximately equal to PMAS thiram, the standard fungicide. Spring dead spot of bermudagrass appeared in Sunturf four years after the variety was planted. No trend in relation to management appeared. The disease did not appear in the U-3 variety.

SUPPORTED BY U.S. Dept. of Agriculture

4.0450, PESTICIDE RESIDUES IN FOODS - REMOVAL, DEGRADATION, AND ANALYSIS

D.D. BILLS, Oregon State University, Agricultural Experiment Sta., *Corvallis, Oregon* 97331 (ORE00733)

OBJECTIVE: Evaluate and develop methods for foods for removing pesticides by processing, assaying pesticide degradation induced by metabolism or processing, analyzing the pesticide content qualitatively and quantitatively.

APPROACH: Removal to be based on development of new processing methods; conventional methods processing generally ineffective for most foods. Degradation can be investigated by gas chromatography, mass spectrometry; possible that many degradation products not yet known. Analytical methods need improvement; especially need methods for positive identification of residues isolated from foods. Molecular distillation, degradation by ultraviolet light followed by gas chromatographic analysis show promise as analytical tools.

PROGRESS: Peanuts fumigated with methyl bromide were found to display a flavor defect following roasting. Development of the defect was traced to the reaction of methyl bromide with methionine to yield methyl-S-methionine sulfonium bromide. The latter compound is readily decomposed upon heating to yield dimethyl sulfide, a potently odorous compound. Peanuts fumigated at approved levels had a mild off-flavor immediately following roasting. Peanuts fumigated at excessive levels had pronounced, undesirable off-flavor. The results of repeated fumigations were found to be cumulative with respect to the production of off-flavor following roasting.

SUPPORTED BY U.S. Dept. of Agriculture

4.0451, WEED CONTROL IN HORTICULTURAL CROPS

G. CRABTREE, Oregon State University, Agricultural Experiment Sta., *Corvallis, Oregon* 97331 (ORE00358)

OBJECTIVE: Develop weed control practices for use in horticultural crop production. Determine the effects of important factors influencing the results of these weed control practices. Conduct studies of a fundamental nature in relation to the action of herbicides. Improve techniques used in weed control research.

APPROACH: Field and greenhouse evaluation of new chemicals of potential value as selective herbicides for use in horticultural crops grown in Oregon. Field and greenhouse studies of crop plant tolerance to herbicides, residual life of herbicides in soil, and the influence of environmental and application variables on plant response to herbicides. Laboratory studies of herbicide effects on plant constituents.

PROGRESS: Weed control studies in 1969 included field trials on snap beans, beets, broccoli, sweet corn, cucumbers, onions, peas, cranberries, apples, cherries, pears, prunes and Easter lilies. Field results would indicate that chloroxuron as an early post-emergence treatment can replace the several chlorpropham-CDAA applications now being used on onions growing on peat soils. A number of new herbicides appear promising in the vegetable crops listed above but commercial development will not be forthcoming for several years on many of them. A three year project on cranberries was completed with the result indicating that serious yield reductions may result from herbicide applications made after the rough-neck stage of development. This time will vary with seasonal temperature variations. Screening of new herbicides on tree crops has resulted in the selection of several chemicals for further evaluation but these will also be several years away from commercialization. A study of herbicide levels following repeated applications in a pear orchard is being terminated with chemical analyses of the soils yet to be completed.

SUPPORTED BY Oregon State Government

4.0452, INVESTIGATIONS ON THE INFLUENCE OF HERBICIDES IN RELATION TO CROP PRODUCTION

S.C. FANG, Oregon State University, Agricultural Experiment Sta., *Corvallis, Oregon* 97331 (ORE00141)

OBJECTIVE: Study the influences of herbicides on metabolic pathways in higher plants; study the influences of plant growth regulators on biochemical processes related to fruit development; study the effect of various climatic factors, such as soil temperature, light intensity, and photoperiod on metabolic pathways of certain vegetable crops; study the effect of ionizing radiation on some biochemical processes related to growth; and relate the observed phenomena to growth and development of Oregon crops under investigation.

APPROACH: Tracer technique will be mainly employed in these studies. Plant tissues, with or without treatment of herbicides or related chemicals, from plants grown under various climatic conditions, or with and without exposure to radiation, are incubated in medium containing radioactive substrate (glucose, acetate, succinate, glutamate, etc.).

PROGRESS: In the course of investigations of the mechanism of 2,4- D action, a study of absorpiton and subcellular binding of C-2,4-D in corn tissues was carried out. Results revealed that, as time of incubation increased, more of the absorbed 2,4-D was bound to particulate fractions in which the formation of 2,4-D metabolites was taking place. Under similar conditions, more 2,4-D was absorbed by the root tissues and bound to the particulate fractions than that absorbed by the stem tissues. Extraction of corn root particulate fractions with alcohol and chromatography of the extracts revealed the presence of 9, 12 and 29% of 2,4-D in the nuclear, mitochondria and microsomal fraction respectively; and the remaining radioactivity was due to several metabolites. There were no 2,4-D metabolites found in the supernatant. Sephadex gel filtration of the supernatant from corn root tissues showed no protein-bound 2,4-D. The second

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phase of investigation involved a time course study on the effect of 2,4rD on the metabolism and incorporation of specific labeled glucose into corn and pea tissues. The result showed a preferential release of C-1 of glucose as CO(2). At inhibitory 2,4-D concentration, the glucuronic acid pathway was stimulated greatly in pea roots, slightly in corn stems, and was inhibited in corn roots, while the pentose phosphate pathway was affected in an opposite pattern.

SUPPORTED BY U.S. Dept. of Agriculture

4.0453, FACTORS INFLUENCING THE EFFECTIVENESS OF HERBICIDES

V.H. FREED, Oregon State University, Agricultural Experiment Sta., *Corvallis, Oregon* 97331 (ORE00348)

OBJECTIVE: Obtain information on the chemistry of the herbicides and to evaluate the chemical properties of the compound as it relates to its effectiveness as a herbicide or plant growth regulator; to study the physical biochemistry of the compounds and its solutions as it may relate to their mode of action and their effectiveness; to investigate the mode of action of herbicides on plants with the view of increasing the usefulness of present materials and to work toward more effective and selective herbicides; and to study the relationship of chemical constitution to biological activity.

APPROACH: A number of factors are felt to be involved in the biological action of chemicals including metabolism of the compound by the plant. Studies on this project have been concerned with oxidation of certain herbicides by plants and enzyme systems derived from plants. The results appear to indicate that the plants ability to metabolize the chemical is probably one of the factors in selective toxicity.

PROGRESS: An analytical method was developed and applied to the analysis of 1-naphthaleneacetic acid (NAA) in cherries. The method involves alkaline extraction and digestion of cherries to extract and hydrolyze conjugates of NAA. The NAA is nitrated to permit its detection by electron capture gas chromatography. Application of the method to treated cherries showed there was no detectable residue of NAA, even though the method is capable of detecting 0.05 ppm of chemical. A method for determining residues of MCP in wheat was also developed. The method involves alkaline extraction and purification of the extract on basic alumina adsorbent. The analysis of treated wheat is in progress. A number of soil samples were analyzed for herbicide residues. As in the past, carry-over problems were most frequently encountered with the urea and triazine herbicides when crop rotation is practiced.

SUPPORTED BY U.S. Dept. of Agriculture

4.0454, IMPROVEMENT OF YIELD AND QUALITY OF HOPS

C.E. HORNER, Oregon State University, Agricultural Experiment Sta., *Corvallis, Oregon* 97331 (ORE00036)

OBJECTIVE: Overall objectives of OAES Project 36 are to conduct research for improvement of yield and quality of hops by production practices, development of improved varieties, control of hop pests and diseases, and chemical evaluation.

APPROACH: Research in the department of Farm Crops involves production and breeding. The breeding program consists of developing lines from crosses of Wild American and introduced clones of hops for the purpose of combining good agronomic traits, resistance to diseases, and acceptable quality. Breeding schemes utilize modified recurrent selection, back crossing, and polyploidy. Since the only hop breeding program in the United States is headquartered at Corvallis, Oregon, varieties will be developed for Oregon, Washington, California and Idaho. Production research consists of development of agronomic practices which increase yield, improve quality, or reduce production costs. It involves studies of cultural practices, plant response to chemical treatment, and harvesting and drying procedures. Both phases of research are supported by basic studies in botany, physiology, genetics, and plot technique.

PROGRESS: Crosses were made to study inheritance of alpha acid, downy mildew resistance and European aroma and flavor characteristics. Sixteen clones were selected from a nursery of previous crosses to advance toward new varieties. Twenty-one clones were selected from an observation block for advancement. Three previously selected clones were grown in two-acre commercial plots to obtain sufficient hops for brewing tests. Twenty-one clones were rated for commercial potential and six were submitted to brewers for their evaluation. Crosses between tetraploids and normal diploids produced numerous triploids which were naturally female-sterile (seedless). Resistance to downy mildew and Verticillium wilt was identified in numerous clones. Storage stability of commercial varieties and experimental lines was evaluated and a method for early recognition of deterioration in storage was developed. Residue and efficacy data on gibberellin A(3) was submitted to FDA and USDA and registration for use on hops was obtained. A completed two- year study on efficacy and residues of the insecticide phorate revealed good insect control and no residues in fresh or processed hops.

SUPPORTED BY Oregon State Government

4.0455, BIOLOGY AND CONTROL OF ENTOMOLOGICAL PESTS OF TREE FRUITS

S.C. JONES, Oregon State University, Agricultural Experiment Sta., *Corvallis, Oregon* 97331 (ORE00089)

OBJECTIVE: The control of entomological pests of tree fruits with chemicals. Includes biological studies of the pests and make residue analyses. Explore the possibilities of biological control of orchard pests. Determine the effect of chemical control on parasites and predators of harmful orchard pests. Determine if certain cultural practices are practical in control of orchard pests. Determine the phytotoxicity of the chemicals, make surveys of orchard pests.

APPROACH: Chemical control-testing of new materials against codling moth, mites and aphids; control by tree injection or trunk spraying. Biological control and residue studies.

PROGRESS: Cherry Fruit Fly Control: Technical malathion (95%) applied as an ultra low volume spray continued to give satisfactory control of the cherry fruit fly. This method of spraying was tested against the cherry fruit fly in a heavily infested cherry orchard near Eugene, Oregon. The material was applied by helicopter at the rate of 1/2 pint and 1 pint per acre. The best control resulted when the material was applied at the rate of 1 pint per acre. The results were based on five applications applied at approximately 7 day intervals. Gardona, Zolone and Furadan, organo phosphate insecticides, were screened for cherry fruit fly control in the Entomology Cherry Orchard. The sprays were applied with a power sprayer using hand guns. Results were inconclusive due to the low population of flies in the orchard. Plum Aphid Control: Zolone EC and WP were compared for plum aphid control in the Entomology Plum Orchard. Results show both formulations of Zolone effective against the plum aphid under a moderate aphid infestation. Codling Moth Control and Residue Studies: Gardona residue studies were conducted on apples receiving the normal number of Gardona sprays for codling moth control. Samples of apples were taken immediately after the last cover spray was applied and three days later and at the normal harvest date. Excellent control of codling moth was obtained with Gardona 75%, 10/100 based on three cover sprays.

SUPPORTED BY Oregon State Government

4.0456, BIOLOGY AND CONTROL OF ENTOMOLOGICAL PESTS OF NUT CROPS

S.C. JONES, Oregon State University, Agricultural Experiment Sta., *Corvallis, Oregon* 97331 (ORE00088)

OBJECTIVE: Chemical control of pests of nut crops. Biological control; Cultural control; Residue studies; Insect surveys.

APPROACH: Chemical control against the Filbert Moth, and the Big Bud Mite. Study the biology of the Big Bud Mite. Further residue studies of Guthion.

PROGRESS: Filbertworm Control: Gardona 75% WP, 10/100 was screened for the control of the Filbertworm. Sprays were applied on July 15 and August 15. The material showed considerable promise under a moderately low infestation. Filbert Bud Mite Control: Dow Chemical Company Plictan and Ciba C-2307 was tested as a single spray against the Filbert Bud Mite. Ciba C-2307 showed some promise of controlling this pest.

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SUPPORTED BY Oregon State Government

4.0457, WEED CONTROL IN FORAGE CROPS GROWN FOR SEED PRODUCTION

W.O. LEE, Oregon State University, U.S.D.A. Crops Research Div., *Corvallis, Oregon* 97331 (0710-01-18)

OBJECTIVE: Develop methods for safe, efficient, and economical control of weeds in forage legume and grass seed crops. Prevent contamination of crop seed by objectionable weed and foreign crop seed. Control volunteer crop seedlings so that genetic purity of perennial seed crops can be maintained. Develop production methods which will assure seed consumers of an abundant dependable supply of high quality seed at reasonable prices.

APPROACH: Evaluate new herbicides for selective control of weeds in seed crops. Study life cycles of troublesome weeds to determine at what stage of development herbicides can be used most effectively. Evaluate the effect of herbicides upon the crops to avoid adverse effects on crop stands, seed production, seed germination, genetics of seed, or other factors influencing seed quality. Characterize persistence of selected herbicides in soil.

PROGRESS: Six Kentucky bluegrass varieties differed in their response to terbacil and bromacil applied pre-emergence, or at the 2- to 4-leaf stage. Annual bluegrass was selectively removed from seedling perennial bluegrass by terbacil and bromacil at rates of 0.5 lb/A. Higher rates resulted in moderate to severe injury to some varieties. Terbacil at 0.75 or 1.0 lb/A selectively removed bromus tectorum from established Kentucky bluegrass and chewing fescue in eastern Oregon without noticeable injury to the crops. Rates of diuron, simazine, atrazine, and prometryne necessary for good weed control did not usually cause reductions in seed production of perennial grasses when applied after November 1. Propham and chlorpropham usually reduced yields when applied after this date at rates providing effective control. Midwinter applications of paraquat or diquat removed winter annual grass and broadleaf weeds from red and white clover seed fields without adversely affecting production or germination of clover seed.

SUPPORTED BY U.S. Dept. of Agriculture

4.0458, DEVELOPMENT OF AERIAL & GROUND TREATMENTS FOR CHEMICAL CONTROL OF BRUSH SPECIES IN FOREST LANDS

L.A. NORRIS, Oregon State University, Agricultural Experiment Sta., *Corvallis, Oregon* 97331 (ORE00465)

OBJECTIVE: Determine the impact of aerially applied herbicides on the quality of the forest environment. Provide the land manager with a basis for estimating potential hazard of a proposed spray project. Provide a scientific basis for the formulation of sound forest spray policies.

APPROACH: Field and lab monitering of operational aerial brush control projects and determination of resulting residues. Field and lab studies of initial herbicide distribution and subsequent movement and fate in various portions of the forest environment.

PROGRESS: The kinetics of adsorption of 2,4-D, 2,4,5-T amitrole and picloram on forest floor material are under investigation. The forest floor material includes all material overlying the mineral soil. The forest floor is a major receptor of aerially applied herbicides and thus the behavior of herbicides in this layer is important from aspects of environmental pollution, as well as herbicidal effectiveness. In these studies of adsorption on forest floor material, solutions containing the above herbicides at 1 x 10 molar concentration are agitated with forest floor material in a ratio of 1 part solid to 10 parts liquid at intervals the amount of chemical sorbed is determined and the time to reach equilibrium noted. In addition, the distribution of herbicides between liquid and solid is also determined. Summary of results obtained at 30 C for Herbicide, Equilibrium Point, % Sorbed, Time to 75% Equilibrium and Time to Equilibrium, respectively are as follows: 2,4-D, 26, 10 minutes, 60 minutes; 2,4,5-T, 50, 10 minutes, 60 minutes; amitrole, 73, 6 hours, 48 hours; picloram, 27, 1.5 hours, 6 hours.

SUPPORTED BY Oregon State Government

4.0459, TURFGRASS WEED CONTROL

J.M. DUICH, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01664)

OBJECTIVE: Determine the effectiveness, longevity and selectivity of preemergance herbicides on annual grass weeds; postemergence herbicides on broad-leafed weeds; and pre- and postemergence herbicides on seedling weeds in newly established turf with emphasis on non- phytotoxicity to the various turfgrasses.

APPROACH: Multiple location field tests on natural and seeded stands will be conducted. Preemergence chemicals to be evaluated with variable formulations, turf species and application date. Bioassays will be utilized in greenhouse studies. Post-emergence broadleaved weed herbicides will be evaluated with emphasis on broad spectrum control from a single application. Early postemergence herbicide activity on seedling weeds in newly established turf stands will be appraised in order to improve stands, extend turf establishment periods and to renovate deteriorated swards.

PROGRESS: Evaluation of bensulide in program approach to Poa annua control in putting greens continued for fifth consecutive year. Maximum varietal injury to date resulted from cold, open winter of 1968-69. Differential varietal foliar injury encountered with injured root recovery inhibited by bensulide. Glass rootbox studies on field-treated samples confirmed suspected inhibition of new root initiation by presence of highly insoluble surface chemical barrier. Old Orchard and Penncross bent most severely affected in 1969; a varietal injury shift from 1968. Bensulide treatments resulted in near 100% control from consecutive year treatments. Crabgrass control studies with combination pre- and post emergence chemicals proved very effective on early postemergence of crabgrass up to one month with a single application.

SUPPORTED BY Pennsylvania State Government

4.0460, MICROANALYSIS TECHNIQUE TO DETECT HERBICIDES AND THEIR DEGRADATION

R.H. HAMILTON, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01620)

OBJECTIVE: Develop methods for detection of herbicides in cells and tissues; obtain information on tissue localization of herbicides.

APPROACH: Autoradiographic as well as standard biochemical methods will be applied to the detection of herbicides. Other techniques will be explored to indicate their value.

PROGRESS: The time course for C -labeled 2,4-D metabolism in bean plants indicates that 4-hydroxy-2,5-, and the 4-hydroxy-2,3- dichlorophenoxyacetic acid glycosides are major stable metabolites in the plants after 3 weeks. At shorter times considerable quantities of the aglycones accumulate. The radioactivity in the 80% ethanol insoluble residue gradually accumulates and is second only to hydroxylated glycosides after 3 weeks. A column chromatography method for dealkylatedamino atrazine metabolites has been developed. A gas chromatography method using a fluorinated acetylating reagent for 2- chloro- S-triazine is under investigation. It has not been possible to show specific localization of H-C-chloroisopropyl-N-phenyl carbamate in root tips even though extensive chromosomal modification is noted.

SUPPORTED BY Pennsylvania State Government

4.0461, MECHANISMS OF PLANT GROWTH REGULATION

R.H. HAMILTON, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01799)

OBJECTIVE: Investigate mode of action of plant growth regulators and herbicides; determine reasons for selectivity of herbicides; investigate normal control mechanisms in plant growth and development.

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APPROACH: Probability that auxins or auxin-like herbicides act at the level of the genome in promotion of cell elongation will be investigated. Use of UV light as an inhibitor will be further characterized. Enzymatic activities elevated under the influence of auxin will be examined for evidence of de novo synthesis. Metabolites of 2,4-D will be investigated. Selectivity of S-triazine herbicides will be examined to determine if acute toxicity is caused by ammonium ion toxicity or photorespiration. State of indoleacetic acid in bean apical meristem and the in vivo biosynthesis of indoleacetic acid will be investigated.

PROGRESS: The 3 hour pattern reported last year on RNA of Avena coleoptiles after exposure to ultraviolet light was not always observed. Sometimes we observed a normal light ribosomal RNA peak and more soluble RNA. Incubation with H-uridine resulted in incorporation into the soluble fraction, with or without UV treatment. We have examined the selective inhibition by UV or the incorporation of labeled proline into wall protein. Label in the wall and the TCA soluble fraction was confirmed to be largely hydroxy-proline in contrast to C-proline present in the soluble protein. Preliminary work has shown the incorporation of H-Tdr into DNA of this nondividing coleoptile tissue, and apparent stimulation of incorporation following UV exposure. We were unable to isolate enough of the indole bean unknown for identification, and have turned to the biosynthesis of IAA. We confirmed the poor growth response of sterile Avena coleoptile tips to tryptophan. Tryptophan- C was taken up, but very little C-IAA was detected. In bean plants C- tryptophan was a poor precursor but indole was converted to IAA in detectable amounts. Soybean cotyledon cultures have a large pool of free tryptophan but require an exogenous auxin, however they convert added tryptophan- C to IAA.

SUPPORTED BY U.S. Dept. of Agriculture

4.0462, SUGAR BEETS FOR PENNSYLVANIA

A.S. HUNTER, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01544)

OBJECTIVE: Obtain further information on the potentials for sugar beet production in Pennsylvania.

APPROACH: Test plantings of sugar beets will be made each year on two or more sites in central and southeastern Pennsylvania. Major emphasis will be on determining the magnitude of yields and the quality. Application of techniques and information on adaptation. Variables may include varieties, row spacings, plant populations, soil fertility levels, methods of weed control, time of planting, depth and time of plowing, and preceding crop. All experiments will be laid out in accordance with the principles of modern statistical design. Determinations will be made of yields, per cent extractable solids, and per cent sugar.

PROGRESS: No research on sugar beets was done in 1968. In 1965, 1966 and 1967 it was demonstrated that sugar beets can be grown in Pennsylvania, with yields and sugar contents similar to those of other eastern areas of the U.S. where beets are grown commercially. It is anticipated that some sugar beets will be grown in Pennsylvania in 1969 and the project will be kept open for possible work on the subject of herbicides, herbicide residues and fertilizer response.

SUPPORTED BY Pennsylvania State Government

4.0463, DEVELOPMENT OF THE EASTERN SPRUCE GALL APHID AND ITS CONTROL

W.H. KEARBY, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01750)

OBJECTIVE: Evaluate the development of the aphid in Pennsylvania, develop effective and safe methods of chemical control.

APPROACH: Development of the aphid will be evaluated in the field, greenhouse, and biotrons. Data will include fundatrix development, oviposition, hatching, and nymph establishment in galls. Development and behavorial studies in biotrons will provide data difficult to evaluate in the field. Phenological data from state locations will aid in spray schedule determination. Field plots within the state will be established, and treated with labeled and experimental insecticides for best control. Dosage levels and rates of application will be tested. Plots will be replicated; data statistically analyzed. Phytotoxicity will be determined.

PROGRESS: A number of insecticides were evaluated for the control of the spruce aphid. It was found that the time of application was a critical factor in the control of this insect. Lindane proved to be superior to other materials tested. The development of galls was studied and it was found that fully developed galls occurred only when female feeding occurred in conjunction with oviposition. Feeding alone only stimulated a false gall. As of September 30, 1969, Dr. W.H. Kearby, project leader, resigned to accept a position at the University of Missouri. Dr. B.F. Coon, Department Head, has appointed a committee to find a replacement. Candidates are being screened and it is expected the position will be filled in early 1970.

SUPPORTED BY U.S. Dept. of Agriculture

4.0464, BIOLOGY AND CONTROL OF INSECTS IN DECIDUOUS FORESTS AND CHRISTMAS TREE PLANTATIONS

W.H. KEARBY, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01833)

OBJECTIVE: Describe the biology of Physostegania pustularia, a spanworm on red maple, and Eulachnus agilis, an aphid on Scotch pine; evaluate temperature, humidity, and light factors; develop population management programs for the Cooley spruce gall aphid, and pine tortoise scale.

APPROACH: The biology of P. pustularia and E. agilis will be studied in the field and laboratory. The behavioral habits, feeding, sex ratios, mating, fecundity and longevity will be recorded during development. Temperature, light, humidity, and wind will be evaluated in the field and correlated with laboratory environmental growth chamber studies. Portable field monitoring equipment will be used when possible. Insecticides will be tested in Christmas tree plantations with aerial, ground and compressed air sprayers for control of the Cooley spruce gall aphid and the pine tortoise scale. Careful screening for low dosage levels will be studied to limit contamination of the environment.

PROGRESS: Field tests continued on the control of the of the aphids, Eulochnus agilis and Cinara pinea, on Scotch pine. Temik continues to give excellent control of the pests throughout the season. Dieldrin, dimethoate and endosulfan were evaluated as stump sprays for the control of the pales weevil and the northern pine weevil. Dieldrin gave nearly complete control of these pests. As of September 30, 1969, Dr. W.H. Kearby, project leader, resigned to accept a position at the University of Missouri. Dr. B.F. Coon, Department Head, has appointed a committee to find a replacement. Candidates are being screened and it is expected the position will be filled in early 1970.

SUPPORTED BY U.S. Dept. of Agriculture

4.0465, FOOD CONTAMINATION CONTROL WITH EMPHASIS ON QUALITY AND MARKETABILITY

M. KROGER, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01764)

OBJECTIVE: Develop and improve analytical methods for food additives, contaminants, and trace components and study their changes during processing that might influence marketability and consumer acceptance.

APPROACH: Modern tools of microchemical analysis, such as thin- layer, and gas-liquid chromatography, mass spectrometry, atomic absorption spectroscopy and neutron activation analysis, will be employed. Processing operations such as heating, dehydration, and freezing of various foods will be investigated, particularly their effects on microconstituents. Specifically, investigations on potato chip color, on pyrolysis during meat product preparation, or components of fermented foods (cheese, cocoa products, cured meat) and on low-ash food will be conducted. All studies will have consumer acceptance and marketability as their guidelines.

PROGRESS: Work was completed on research showing that the site of contamination of raw cocoa beans with organochlorine hydrocarbon pesticides is the shell and that the contaminants are removed with the shell during further processing of the bean. Work is underway on a rapid method to assess the extent of pesticide contamination on cocoa beans. A survey of more than 30 cocoa bean samples is being conducted to indicate the general level of pesticides on raw cocoa beans.

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SUPPORTED BY U.S. Dept. of Agriculture

4.0466, PESTICIDE APPLICATION COSTS AND CHEMICALS FOR PEST CONTROL ON FRUIT

F.H. LEWIS, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01578)

OBJECTIVE: Determine relationship between frequency of application and amount of chemicals per acre required for pest control. Data will be sought on costs, chemical coverage, deposit spray droplet sizes, spray injury and pest control using different methods and types of machinery.

APPROACH: Apply 1/3 normal amount of chemical at twice normal frequency, apply 2/3 normal amount of chemical sprayed one side one week and opposite side following week (about twice normal frequency), using time studies and cost calculations to compare results, determine coverage and deposit with various types of equipment using chemical analyses, fluorescent chemicals and rating of visible residues.

PROGRESS: Studies have continued in the program of improving pesticide usage and reducing application costs in fruit orchards. A number of procedures have been developed which provide for efficiency in application of pesticides. These include: special pruning; standardization of the amount of dilute spray used in calculating all chemical requirements (40 gal per acre is standard); use of concentrate sprays for airblast sprayers with the amount of chemical per acre calculated at 18% less than with dilute sprays; use of airblast sprays with a pump pressure of about 200 psl, nozzles of ceramic or special metal, and the ability to blow the spray into and well above the trees against a wind of 5-8 mph; control of the rate of travel while spraying, usually at 2 mph; and spray from alternate row middles at fixed intervals, usually 7 days. Alternate row spraying of pruned trees at fixed intervals with adequate equipment has helped to maintain a relatively fresh deposit of short-life chemicals, has permitted an additional reduction of 33% in chemical usage on many orchards and has given promising results as part of a system of integrated chemical and biological control of mites.

SUPPORTED BY Pennsylvania State Government

4.0467, TRANSFORMATION OF INSECTICIDES BY PLANTS

R.O. MUMMA, Penn. State University, Agricultural Experiment Sta., *University Park, Pennsylvania* 16802 (PEN01712)

OBJECTIVE: Identify the products of degradation of insecticides by plants and determine the quantitative significance of those products. Determine the absorption and translocation of insecticides and their degradation products by plants. Investigate the mechanisms of decomposition of insecticides by plants.

APPROACH: Radiolabeled pesticides will be used to follow their absorption, translocation and metabolism in plants. The transformed pesticides will be isolated by thin layer, column and gas chromatography. Their structures and properties will be determined. Infra-red, nuclear magnetic resonance and mass spectroscopy will be employed in the structural identification of these compounds. After a metabolite has been identified, the mechanism of its formation will be investigated. Whole plants and particular fractions of these plants will be used for enzymatic studies of the transformation of the pesticides.

PROGRESS: The metabolites of carbaryl in bean plants have been isolated and are being characterized. The suspected metabolites are being synthesized in an effort to compare the mass spectra of the isolated molecules versus the synthetic molecules. Various parameters of laser ionization mass spectroscopy, such as sample preparation, quantity, and chemical and physical form were investigated.

SUPPORTED BY U.S. Dept. of Agriculture

4.0468, THE ROLE OF RHIZOSPHERE MICROORGANISMS IN THE ACTION OF HERBICIDES ON PLANTS

D.D. KAUFMAN, Coll. of Agriculture, *Wroclaw, Poland* (E21-CR-73)

OBJECTIVE: Determine interaction effects of herbicides and rhizosphere microflora on antibiosis, changing phytotoxicity, selectivity, and multiple pesticide effects.

APPROACH: Interaction studies using 3 herbicides, 1 fungicide, and 1 insecticide on soil microorganisms and plants will be conducted in the laboratory, greenhouse, and field experiments. Laboratory studies will determine action of herbicides on plants grown in sterile environment and in combination with selected soil microorganisms. Greenhouse studies will include an examination of the changes in herbicide action on the plant affected by microorganisms. Field experiments will be concerned with the interaction effects of herbicides, fungicides, and insecticides on soil microbial ecology. Sugar beet will be the test plant in all studies. Microbiological processes to be examined are ammonification, nitrification, cellulose decomposition and CO(2) evolution.

PROGRESS:

SUPPORTED BY U.S. Dept. of Agriculture

4.0469, HERBICIDE EFFECTS ON RESISTANT WEED, CORN, AND ROTATIONAL CROPS IN POLAND

J.T. HOLSTUN, Inst. of Cult. Fert. & Soil, *Wroclaw, Poland* (0710-01-33)

OBJECTIVE: Characterize the effects of herbicide combinations used in rotations of corn with oats, rye, potatoes, broad beans, wheat, and sugarbeets with respect to (a) control of resistant species of weeds; (b) yield and quality of the crops; and (c) herbicide residues in soil and in the crops.

APPROACH: Apply different herbicides in succession during three, 4-year rotations (corn-broad beans-wheat-sugarbeets on light and on heavy soil; and corn-oats-rye-potatoes on light soil) in replicated field plots. Record observations of effects on weeds and crops; count and estimate weeds; measure yields of crops; analyze crops quantitatively for N, P, K, ash, fat, starch, and sugar; determine changes in content of free amino acids, sugars, organic acids, and chlorophyll in grass crops, and in selected weeds; and determine residues of herbicides in plants and soil via biological assays, chemical methods, and gas chromatography.

PROGRESS: Studies on rotations of weed control treatments within rotations of corn, small grains, potatoes, broad beans, and sugarbeets were initiated in 1968. The herbicide 2,4-D inhibited the development of lateral roots of corn as compared with roots in control plots, but use of the other herbicides increased development of lateral roots. Propachlor controlled Echinochloa crusgalli more effectively than did simazine or atrazine, but was less effective on Viola arvensis, Chenopodium album, and Thlaspi arvense. These weeds plus Geranium spp., Galium aparine, Veronica spp., Galinsoga parviflora, Capsella bursa- pastoris, Urtica urens, Stellaria media, Convolvulus arvense, Equisetum arvense, Lamium purpurem, and Polygonum convolvulus predominated in the experimental areas. Mixtures of ioxynil plus mecoprop, simazine plus terbutryne, and propachlor plus simazine generally were more effective than single herbicides applied alone, primarily because of the diversity in species of weeds.

SUPPORTED BY U.S. Dept. of Agriculture

4.0470, CONTROL OF WEEDS IN CROPS OF ECONOMIC VALUE

H.R. CIBES, Univ. of Puerto Rico, Agricultural Experiment Sta., *Mayaguez, Puerto Rico* (PR00173)

OBJECTIVE: Secure information on the use of herbicides under local conditions and study the effects of herbicides on major crops and major weeds in important production areas.

APPROACH: A screening program will be developed in the greenhouse to test the maximum safe dosage of herbicides for crops, and maximum effective dosage for the control of important weed species. Promising herbicides will be evaluated under field conditions. Herbicides will be applied to plots, in at least 4 dosages and different formulations, by means of knapsack sprayers, logarithmic machine sprinkling cans, or cyclone applicators; depending on the kind and form of the product to be used. Rochecouste herbicide evaluating techniques will be adopted for sugarcane. Plant and soil samples will be analyzed for residues in accordance with Federal Pesticide regulations.

PROGRESS: Various combinations of Sinbar and Ametryne were applied preemergently to plots of P.R.980 infested with Bermuda grass, nutgrass and other weeds. Production of cane and sugar per acre, as well as, sucrose content was very high for all treatments. This indicates that there were, apparently, no ill effects from such treatments upon the growth and quality of the crop. In fact, there were no statistical differences between treatments except in the case of one treatment, Sinbar 2 lb/A and Ametryne 3 lb/A. Sugarcane plots treated with this herbicide combination yielded significantly more sugar than the rest of the plots, that is, 177 hundredweights against 137, 147, 144, 150, 141, and 163 hundred-weights for the other treatments. In two trials carried out at the Fortuna Substation, Sinbar applied at rates of 1, 2, 3 and 4 lb/A alone or combined with Karmex and Ametryne had no deleterious effects on Bermuda grass and nutgrass.

SUPPORTED BY U.S. Dept. of Agriculture

4.0471, CONTROL OF WEEDS

H.R. CIBES, Univ. of Puerto Rico, Agricultural Experiment Sta., *Mayaguez, Puerto Rico* (PR-C-00288)

OBJECTIVE: Develop information on new herbicides under climatic and production conditions in Puerto Rico including effects of herbicides on major crops and major weeds in the important production areas.

APPROACH: A screening program will be developed to test the maximum safe dosages of herbicides for crops and minimum effective dosages for control of important weed species. Critical field evaluation will be made of promising herbicides on important crops such as sugarcane, coffee, pineapple, tobacco and pastures studying the effect of such variables as dosage, formulation and method of application, stage of development of both crops and weeds and environmental factors. Problems of persistence of the herbicides in soils and in the harvested produce will be considered. Laboratory and greenhouse studies will be initiated on problems selected from the field.

PROGRESS: Several experiments were carried out in an effort to develop information on the use of herbicides in such crops as coffee, yams, and tanniers. The following is a brief account of the results obtained: In coffee: (a) In a semi-controlled experiment in the Main Station it was found that a second Prometryne, Ametryne, and Diuron application at rates of 2, 4, 6, and 8 lb./A was highly toxic to coffee seedlings, specially at the highest concentrations. Among the above mentioned herbicides, Diuron, regardless of concentration, was the most toxic as shown by the highest number of dead trees. (b) Similar results were obtained in a field experiment at the Adjuntas Substation. In tanniers: Synbar, at all concentrations used, was highly toxic to tanniers. Diuron at 4 and 8 lb/A also resulted toxic to this crop. On the other hand Ametryne seemed to be harmless to the treated plants at the various concentrations used. The toxicity of Synbar and Diuron was reflected on the yield of edible roots. In yams: Caparol, Herban, Ametryne, and Diuron were found to be effective for the control of weeds in yam plantings. Diuron at 8 lb./A was somewhat toxic to treated plants. In fact, at the stated rate it drastically lowered the yield of edible roots.

SUPPORTED BY Puerto Rican Government

4.0472, EFFECT OF PROCESSING ON SYSTEMIC PESTICIDES IN COFFEE, PINEAPPLE, AND TOMATO

J. SINGMASTER, Univ. of Puerto Rico, Agricultural Experiment Sta., *Mayaguez, Puerto Rico* (PR00179)

OBJECTIVE: Evaluate effects of marketing processes on systemic pesticide residues by means of residue analysis procedures. Develop new processing methods in cases where present processes are found to increase the overall toxicity of the final product.

APPROACH: The fate of Di-Syston and Bayer 2541 in the processing of coffee, tomato, and pineapple will be investigated using insecticides labeled with radioactive sulfur and tritium. During heating processes involving these crops, vapors from the materials will be collected and analyzed for radioactivity as well as the final products. If any phosphorus compound containing radioactivity is found that does not correspond to the known metabolites of these insecticides, its structure and inhibition of acetylocholinesterase will be determined. If processing procedures are found to concentrate the pesticides or alter them to more toxic compounds, changes in processing will be examined to find ways to prevent the increase in toxicity in the final product.

PROGRESS: This project has remained inactive and will remain inactive until the necessary personnel becomes available.

SUPPORTED BY U.S. Dept. of Agriculture

4.0473, EVALUATION OF HERBICIDES AND THEIR INFLUENCE ON THE PHYSIOLOGY OF VEGETABLE CROPS

W.L. OGLE, Clemson University, Agricultural Experiment Sta., *Clemson, South Carolina* 29631 (SC00684)

OBJECTIVE: Determine which herbicides are most effective in weed control. Develop improved methods of application of herbicides. Establish which herbicides are least injurious to vegetable crops and ascertain the effect of herbicides on the physiology of specific vegetable crops.

APPROACH: Herbicides will be studied in the greenhouse to determine the effect of different rates of herbicides on the physiology of vegetable crops. Germination, root inhibition, formative effects, chlorosis, necrosis, growth rate, nutrient uptake, chlorophyll content, metabolism, flowering and maturity. Herbicides will be evaluated in the field to establish their efficiency in weed control with emphasis on specific weeds controlled. When the usefulness of a herbicide has been firmly established for a crop, the material will be studied under different systems of application and use; preemergence, preplant incorporated, postemergence, irrigation, surface and incorporation depths and seasons of the year.

PROGRESS: Replicated field and greenhouse experiments were conducted to determine the effectiveness of delayed incorporation of nitralin in weed control. Nitralin was applied at varying rates and incorporated after 0,1,3,5,7,8,11,13, and 15 days following application. The results indicated that nitralin at 0.5 lb/A effectively controlled weeds when incorporation was delayed seven days after application. With cucumbers and watermelons where nitralin is applied a 0.5 to 1.0 lb/A preemergence, improved weed control can be obtained by incorporating the material seven days after application which is after the crop emerges. The results of these studies are being carried directly to the growers through Experiment Station publications and grower meetings. Nitrofen at 3 lb/A post transplant has given excellent control of swinecress in cabbage. Swinecress, a winter weed in cabbage, has been particularly troublesome because this weed is not controlled by trifluralin, a widely used herbicide in this crop. Nitrofen at 3 lb/A is being recommended this year for cabbage by the S.C. Extension Service. Depth of incorporation studies conducted with nitralin and trifluralin at 0.5 to 1.0 lb/A indicate that good weed control without crop injury may be obtained when these chemicals are incorporated two to four inches deep.

SUPPORTED BY U.S. Dept. of Agriculture

4.0474, CHEMICAL INVESTIGATION OF SURFACE CONTAMINATION OF COTTON FIBERS

H. PERKINS, Clemson University, U.S.D.A. Market Qual. Res. Dv., *Clemson, South Carolina* 29631 (FC-67)

OBJECTIVE: Determine presence of surface contaminants on cottons of known history and performance and relate differences in fibers due to temperature and moisture variation to spinning quality factors.

APPROACH: Determine by gross chemical analysis surface contamination on cottons of known history. Using paper chromatography make tests for pesticides and defoliants, including their oxidative and thermal degradation products. Presence of chlorides, phosphates, oils, etc., will be determined by chemical analysis and identification by gas chromatography and spectrophotometry. Develop procedures for sampling, blending, solvent extraction, and chemical analysis. Correlate data with cotton quality factors.

PROGRESS: Arsenic acid is widely used as a desiccant to prepare mature cotton plants for harvesting by stripping. Workers have developed severe rashes after handling cotton from fields which had been desiccated with arsenic acid. Since no satisfactory method was available, a rapid method for both qualitative and quantitative detection of arsenic residues on cotton was developed.

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SUPPORTED BY U.S. Dept. of Agriculture

4.0475, BIOLOGY AND CONTROL OF ARTHROPODS ON APPLES

T.E. SKELTON, Clemson University, Agricultural Experiment Sta., *Clemson, South Carolina* 29631 (SC00897)

OBJECTIVE: Determine significance and biology of arthropods on apples in Piedmont South Carolina. Develop and keep current an integrated pest management program for reducing arthropod damage to apples.

APPROACH: Examine orchards in apple areas of S. C. at intervals during growing and dormant season for destructive and beneficial arthropods and make observations on biology. Locate and indentify the natural parasites or predators of pests. Screen insecticides and acaricides for effects on pests and beneficial arthropods. Observe and record any phytotoxicity from chemicals. Utilize resulting data to formulate practical pest management program.

PROGRESS: Initial surveys indicated that the European red mite, Panonynchus ulmi (Koch), and the two spotted mite, Tetranychus urticae (Koch), are the most important arthropods on apples in South Carolina at the present time. Initial observations indicated the red mite to be the prevalent species early and late with the two spotted mite prevalent in mid-season. Ten acaracides were applied as sprays to young apple trees on July 8. A single application of seven of the compounds evaluated provided adequate control for 8 weeks. These were Acarol, Carzol, Fundal, Monitor, Omite, Plictran and Zolone. Subject to availability, these compounds will be included in field experiments next year.

SUPPORTED BY U.S. Dept. of Agriculture

4.0476, IMPROVEMENTS OF FLUE-CURED TOBACCO BY DEVELOPMENT OF MORE ADEQUATE FERTILIZATION, AND CROPPING SYSTE

R.E. CURRIN, Pee Dee Experiment Station, *Florence, South Carolina* 29501 (SC00386)

OBJECTIVE: Determine which are the best adapted varieties as measured by yield and quality. Investigate the effect of cultural practices such as topping, spacing amount of cultivation on yield and quality. Determine the effect of rates of fertilization on yield and quality of the three leading tobacco varieties.

APPROACH: A variety test together with an advanced strains test will be conducted at three locations to determine productive capabilities as measured by yield and quality. Experiments will be continued on the effect on height of topping of the quality of tobacco leaf produced by the Mammoth tobacco. A fertilizer experiment with varieties such as Hicks, Coker 316 and NC 95 will be initiated to study the effect of rate of fertilization on the yield and quality of leaf produced by these three varieties.

PROGRESS: Tobacco sucker control investigations were divided into 2 tests in 1969. Advanced test consisted of materials that have been evaluated previously. Treatments with contact controls were T-504, T- 585, T-600, T-459 and Royal MH, a systemic with MH-30 for a check. T- 148 and Penar were applied and followed 2 weeks later with MH-30 as a second application. Contact agents T-504 and T-585 gave fair control. The best control of suckers on flue-cured tobacco was Royal MH, T-148 plus MH-30, MH-30 and Penar plus MH-30 in this order. There was no leaf injury. There were 24 treatments in preliminary tests. Some damage was caused to tobacco leaf on 3 of these treatments, however, some treatments gave fair control with no plant damage. Chemical data for 1967 factoral fertilizer experiment involving 3 rates of nitrogen, phosphorous, and potash have been analyzed. Data indicates that nitrogen exerts a very strong influence on the chemical composition of cured tobacco leaf. As rates of nitrogen were increased, percent nicotine increased, percent nornicotine increased, percent total nitrogen increased and the percent potash increased. As nitrogen was increased the percent reducing sugars decreased, and total plant phenols decreased. Increasing rates of phosphorous and potash appear to have very little influence on the chemical composition of cured leaf. The agronomic and chemical data are now in the process of being analyzed.

SUPPORTED BY South Carolina State Government

4.0477, TOBACCO PLANT BED MANAGEMENT RESEARCH

T.W. GRAHAM, Pee Dee Experiment Station, *Florence, South Carolina* 29501 (SC00295)

OBJECTIVE: Develop more adequate plant bed management and procedures which will assure an efficient, sufficient, and dependable supply of vigorous and healthy tobacco seedlings suitable at the proper time for transplanting to the field.

APPROACH: Use of Methylbromide gas treatment as a check for new materials will be tested for efficiency and effectiveness in plant bed treatment. Preliminary results have shown that it is possible to control nematode root knot in plant beds with a surface drench. This research will be continued and additional materials will be tested.

PROGRESS: On January 28th, tobacco plant beds were treated with the herbicide Enide to test the value of weed control in spring treatments. Each of the dosage rates 2, 4, and 8 oz. per 100 sq. ft. were applied to the prepared soil surface and also by mixing with top two inches of soil. Beds were seeded two weeks later. Weed and tobacco plant stands were counted on March 25 and April 7. All Enide treatments had fewer weeds than the untreated control but none was equal to the standard Methylbromide gas treatment. Surface application gave slightly better weed control than soil incorporated treatments. Stand reduction and residual toxicity to tobacco plants was found in the 8 oz. rate but not apparent in the 2 and 4 oz. rate.

SUPPORTED BY South Carolina State Government

4.0478, FUNGITOXICITY AND PHYTOTOXICITY OF PLANT DISEASE CONTROL CHEMICALS

C.M. NAGEL, South Dakota State University, Agricultural Experiment Sta., *Brookings, South Dakota* 57006 (SD00296)

OBJECTIVE: Fungitoxicity of new and promising chemicals to plant pathogens. Effects of selected chemicals on photosynthesis and respiration of treated plants. Dosages and frequency of applications for efficient disease control.

APPROACH: New and promising fungicides will be investigated for their fungitoxicity on various plant pathogens and for their phytotoxicity to plants. Effect of promising fungicides on quality of agricultural products will be determined analyzing respiration and photosynthesis and soluble solids. Disease and yield records will be obtained as a mseaurement of effectiveness and possible toxicity of chemicals. Disease cycle of important pathogens will be investigated to aid in efficient use of the chemicals. Fungicide residues will be determined.

PROGRESS: No progress reported this period (Active project).

SUPPORTED BY U.S. Dept. of Agriculture

4.0479, EVALUATING NEW FUNGICIDES

A.Y. CHAMBERS, West Tenn. Experiment Station, *Jackson, Tennessee* 38301 (TEN00140)

OBJECTIVE: Evaluate new chemicals for control of plant diseases, phytotoxicity and behavior under natural environment.

APPROACH: Seeking control of specific local diseases, use will be made of new fungicides as they become available. They will first be utilized in laboratory and greenhouse experiments, and those that offer promise will be applied to the crops under field conditions. Under environmental conditions existing locally, these tests will also provide some of the data needed for establishing tolerances.

PROGRESS: In soybean seedling disease experiments, 8 of 11 seed treatments increased stands and reduced skimpiness in an early planting of seed with good germination but moderate vigor. Two fungicides were phytotoxic. Addition of molybdenum to treatments did not cause plant injury. Small yield increases were obtained. In another seed treatment experiment, 3 of 4 fungicides increased soybean stands in an early planting of both good and poor quality seed. In a later planting, treatment of either poor or good quality seed did not improve plant survival. Yields were not increased. Evidence on fungicide sprays for lima bean stem anthracnose control indicated that 2 consecutive days of rain are required for serious disease injury. Spraying with maneb after 2 days of rain reduced injury. Six fungicides reduced stem anthracnose injury to lima beans and when sprayed at 7-day intervals beginning at bloom. Seven seed and seed plus soil fungicide treatments to control seedling diseases of sunflowers did not improve plant survival. Survival was reduced by 2 treatments in March and 6 in May. Three of 4 fungicides applied in transplant water to control southern blight were phytotoxic to pimiento pepper.

SUPPORTED BY U.S. Dept. of Agriculture

4.0480, AGRICULTURAL BIOLOGY

J.M. EPPS, West Tenn. Experiment Station, *Jackson, Tennessee* 38301 (TEN-WTES-1)

OBJECTIVE: Evaluate control programs for field crop and vegetable insects, diseases, and nematodes that affect West Tennessee agriculture.

APPROACH: Laboratory and field investigations of field and vegetable crop insects, diseases and nematodes. Evaluate natural and chemical control practices.

PROGRESS: A new race (race 4) of the soybean cyst nematode was found in Dyer County on the resistant Pickett Variety. No source of resistance has been found to date. Field and greenhouse tests with organophosphates and carbamate nematocides-insecticides gave good control of the cyst nematode. Custer, Dyer, and Pickett Varieties have resistance to the Reniform Nematode. There was a comparison of overcoat treatment of cotton seeds against granules and/or sprays. Spraying was more appropriate, but required more attention. Stand was reduced in plots where insecticidal overcoating was investigated. Direct impingement effects as related to droplet size were investigated. Over 80% of all droplets to impinge on a weevil were less than 50 microns in diameter. Significant injury to cotton was obtained in field and greenhouse experiments with combination treatments of herbicides, insecticides, and fungicides. Work was continued with cotton breeding for Verticillium wilt control. Fungicide sprays gave good control of lima bean stem anthracnose. Systemic fungicides controlled loose smut of cereals.

SUPPORTED BY Tennessee State Government

4.0481, EFFECT OF PESTICIDES ON TURF PESTS AND TURFGRASSES

L.M. CALLAHAN, Univ. of Tennessee, Agricultural Experiment Sta., *Knoxville, Tennessee* 37916 (TEN00245)

OBJECTIVE: Determine pesticidal effects on the anatomy and morphology of turfgrasses; persistence of herbicidal residues in different soil types and under various environmental influences in relation to turfgrasses, and evaluate pesticidal effectiveness in controlling diseases, weeds, and insects in turfgrasses.

APPROACH: Superficial shoot injury and cellular malformations or disorders induced in turfgrasses by different rates of selected pesticides will be determined by histological procedures and general observations. Plugs of healthy tifgreen bermuda will be grown over soil samples taken from O-2 and 2-4 inches depth of plots treated with different herbicides to determine herbicidal persistence. Herbicidal persistence will be measured by tissue malformations and inhibition or stimulation of root growth. The effectiveness of different pesticides in controlling diseases, weeds, and insects in turfgrasses will be determined by general observations for percent of pest control.

PROGRESS: Penncross bent green. Following retreatments for a third season, siduron, tri-calcium arsenate, bensulide and bandane resulted in no foliage burn. DCPA, benefin and terbutol caused moderate to severe foliage injury. Pythium Blight caused slight injury in the siduron and tri-calcium arsenate plots beginning in August and caused moderate to severe injury in the bensulide plots beginning in late July, bandane and DCPA plots beginning in mid-July, and benefin and terbutol plots beginning in June. Koban, 4 oz., at 5 day intervals gave better control of Pythium than Dexon or Zineb during a very intensive outbreak of the disease. Tifgreen bermuda green. Following retreatments for a second season, no foliage injury was observed with bensulide and tri- calcium arsenate. Bandane, terbutol, DCPA, and benefin caused slight to moderate injury. Uracil caused moderate to severe injury and siduron caused severe injury and loss of sod. Cool season grass overseedings were thinned from treatments with uracil, benefin, terbutol, bandane and bensulide. Koban was incompatible with spray tank mixtures of auragreen and thiram or other chemical combinations with these fungicides. Auragreen precipitates caused turf burn. Thiram precipitates resulted in loss of fungicidal activity.

SUPPORTED BY U.S. Dept. of Agriculture

4.0482, SELECTIVITY AND MODE OF ACTION OF HERBICIDES

W.A. KRUEGER, Univ. of Tennessee, Agricultural Experiment Sta., *Knoxville, Tennessee* 37916 (TEN00279)

OBJECTIVE: Determine metabolic systems affected by various herbicides, and magnitude of changes brought about by herbicide application. Determine site of action and mode of action of herbicides studied. Discover differences in plant metabolism which may be useful in development of selective herbicides.

APPROACH: Acetanilide and other herbicides will be applied to plants growing in the glasshouse and growth chambers. At specific intervals following herbicide application, plants will be harvested for laboratory analysis of herbicide and herbicide metabolites, and protein and nucleic content and synthesis. Uptake, translocation, and site of accumulation of herbicides will be determined using accepted techniques. Herbicidal responses of resistant and susceptible species will be compared. Partially purified plant homogenate fractions will be used to further study herbicide effects. Species differences which might explain herbicidal selectivity will receive special attention.

PROGRESS: Seed of susceptible plants treated with acetanilide herbicides at planting time do germinate, but development is halted at a very early stage. Setaria spp. developed a club-shaped root tip and root hairs developed nearly to the root tip in treated plants, Cucumber root growth was arrested at an early stage. Corn, revealed no apparent differences. Treatment of 7 to 14 day-old cucumber plants with alachlor resulted in the senescence of the terminal meristems. During the following 10-14 days there is a thickening of the basal stem and an enlargement of the cotyledons. There is a swelling about the base of the cotyledons which gives rise to the new terminal growing points. The new growth appears normal and the enlarged cotyledons senesce about one week after the new growth begins. Light and dark treatments prior to and following alachlor treatments have not affected the herbicidal response unless the dark treatments resulted in an altered development of the plants. Plants thus affected respond as control plants in a similar growth stage. Epinastic responses are more striking in the dark-treated plants.

SUPPORTED BY U.S. Dept. of Agriculture

4.0483, LABORATORY SCREENING OF INSECT CONTROL MATERIALS, BROWNSVILLE

R.L. WALKER, U.S. Dept. of Agriculture, Entomology Research Division, *Brownsville, Texas* 78521 (00ENTMO902460400)

OBJECTIVE: Preliminary evaluation of new chemicals as insect control agents.

APPROACH: Laboratory screening tests of new synthetic and natural materials against selected species of insects and mites as contact, stomach, or systemic insecticides, or feeding inhibitors. Observation of phytotoxic effects.

PROGRESS: The following number of synthetic compounds furnished by 25 industrial and government sources were screened as follows: boll weevil 92, southern armyworm 102, fall armyworm 152, tobacco budworm 181, and the two-spotted spider mite 110. Ninety-five compounds were evaluated for phytotoxicity. Southern armyworms were reared on a large scale for investigation of the sex pheromone. A total of 50,887 abdominal tips were provided for extraction of the pheromone. Fractions obtained in the separation and purification of the pheromone were bioassayed for activity.

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SUPPORTED BY U.S. Dept. of Agriculture

4.0484, BEHAVIOR OF SPECIFIC HERBICIDES IN PLANTS AND SOILS

A.F. WIESE, Southwestern Great Plains Ctr., *Bushland, Texas* 79012 (TEX02181)

OBJECTIVE: Determine the effects of climatic and edaphic factors on movement, persistance, and toxicity of herbicides in soil.

APPROACH: The effect of incorporation, irrigation, rainfall and soil type on the phytoxicity, persistance and movement of 1,1-dimethyl- 3-(gamma, gamma, gamma-trifluoro-M-toly) urea and 2,4- bis(isopropylamino)-6-methylmercapto-S-triazine will be determined. In field studies incorporation will vary from none to 4 inches deep prior to and at planting. Irrigation will vary from various amounts of sprinkling to flooding for cotton and crops that occur in common cropping sequences. Movement and degradation of herbicides in the soil will be determined by bioassay. Soil types will be clay, clay loam, loam, fine sandy loam and loamy sand.

PROGRESS: Tandem disking has proven the best way to incorporate preplant herbicides. Better pigweed control is obtained if herbicides are incorporated 1 to 3 inches with a power rotovator. Trifluralin will persist in soil longer than nitralin. Toxicity of fluometuron, prometryne and trifluralin to cotton and millet in sandy soils was related to the clay and organic matter in the soils. Trifluralin was the most toxic. Prometryne was most toxic when absorbed by shoots of germinating cotton and millet seedlings rather than roots. Prometryne was equally toxic to millet when applied anytime during the first 5 days of germination. Bell jars placed over 8-in. pans which contained 1000 grams of soil treated with trifluralin or nitralin were used. Bell jars contained a septum for taking air samples with a gas tight 10 microliter syringe. Air samples were injected into a gas chromatograph for detection. Nitralin did not vaporize from either wet or dry soil. Trifluralin was much more volatile when sprayed on wet soil than on dry soil. In laboratory and field studies fluometuron readily leached into Amarillo sand and Amarillo fine sandy loam but not into Pullman silty clay loam.

SUPPORTED BY U.S. Dept. of Agriculture

4.0485, FATE OF HERBICIDES IN PLANTS AND SOILS

E.F. EASTIN, Texas A & M University System, Agricultural Experiment Sta., *College Station, Texas* 77843 (TEX01737)

OBJECTIVE: To study fate of herbicides in plants and soils as influenced by environmental factors; determine mechanisms of metabolism and devise methods of modifying rate of dissipation of herbicides.

APPROACH: Standard methods using radiolabelled materials coupled with gas chromatography will be used to study absorption, translocation and fate of herbicides in plants. Effects of light quality, intensity, and duration plus temperature, moisture, soil type and pH on fate of herbicides in plants and soils will be studied. Methods of modifying the rate of herbicidal dissipation will be of two types: modification of the environment and addition of chemicals, or by chemically modifying the herbicide itself.

PROGRESS: A two-dimensional thin-layer chromatographic method for the separation of C-6989 (rho-nitrophenyl-alpha,alpha,alpha- trifluoro- methyl-rho-tolyl ether) and some of its suspected degradation products was developed. Studies were then undertaken to determine the movement and fate of C-6989 in peanuts (resistant) and cucumber (susceptible). Major degradative pathway appears to be cleavage of the ether linkage in both species. Studies were undertaken to determine the relative absorption and translocation of atrazine 2-chloro-4- ethylamino-6- isopropylamino-sigma-triazine in resistant and susceptible selections of corn. Both selections absorbed essentially the same amount of atrazine but the susceptible line translocated more radiolabelled to the shoot than the resistant line. This may result in an overloading of the protective mechanism, resulting in death to the plant. Analyses of stock tanks and ditches indicate that the major loss of picloram occurs in the runoff of the first rainfall. Highest concentration of picloram found in the runoff water was 75 ppb when rainfall occurred within 2 weeks after herbicidal application. There was less than 10 ppb of picloram in the spring runoff from plots treated the following fall. The only indication of ground water contamination was in a well at College Station and this water had less than 1 ppb.

SUPPORTED BY U.S. Dept. of Agriculture

4.0486, EPOXIDATION OF CYCLODIENE PESTICIDES BY SOIL BACTERIA

T.B. GRIFFIN, Texas A & M University System, Agricultural Experiment Sta., *College Station, Texas* 77843 (TEX01697)

OBJECTIVE: An evaluation of cyclodiene epoxidase activity in representative genera of soil bacteria. Isolation of the epoxidase system obtained from a selected bacterial species. Characterization of the epoxidase system and comparison with mammalian and insect mixed function oxidase systems.

APPROACH: The proposed research is designed to provide an insight into problems involving the persistence of and transformations of cyclodiene pesticides in soil. The enzyme system in bacteria which mediates the epoxidation of cyclodiene pesticides will be purified and characterized. The proposed research should also provide information concerning certain phases of bacterial oxidative metabolism and observations in comparative biochemistry.

PROGRESS: The investigator of this project left Texas A&M University in January, 1969. A new investigator assumed responsibility for the project in August, 1969. The new investigator has studied and evaluated the project and it is his desire to proceed with the project objectives as defined by the original investigator.

SUPPORTED BY U.S. Dept. of Agriculture

4.0487, FACTORS INVOLVED IN REACTION OF COTTON TO INSECTS

J. HACSKAYLO, Texas A & M University System, Agricultural Experiment Sta., *College Station, Texas* 77843 (TEX01194)

Objective: Determine physiological reactions of cotton varieties to systemic and other insecticides, particularly the manner in which absorbed or residual compounds may affect growth and maturity of plant, viability of seed, cotton seed and fiber quality, and still maintain insecticidal effectiveness. Conduct investigations on mode of entry, transport and accumulation of insecticides in cotton and possible ways to improve absorption, movement, accumulation and insecticidal effectiveness. Investigate physiological processes involved in phytotoxicity and possible stimulatory action of insecticides or carriers, particularly the systemic type of insecticides. Investigate physiological and developmental responses of cotton to insect attack.

Approach: Cotton plants are grown in solution, sand, and soil. Insecticides are applied to foliage, seed, and/or roots. Physical and chemical measurements are made to determine their effect on growth, development, seed, and fiber properties. Radioisotope techniques are used to study absorption and accumulation and how these processes are affected by light, temperature, and humidity.

Progress: The project leader of this project is no longer associated with the Texas Agricultural Experiment Station and this project has been inactive during the period covered by this report.

SUPPORTED BY U.S. Dept. of Agriculture

4.0488, CYTOGENETIC EFFECTS OF FLUORIDE

G.E. HART, Texas A & M University System, Agricultural Experiment Sta., *College Station, Texas* 77843 (TEX04002)

OBJECTIVE: To determine the cytogenetic effects of gaseous and aqueous solutions of fluoride on plants.

APPROACH: Plants will be fumigated with concentrations of fluoride too low to induce visible injury. The mitotic and meiotic cycles of fumigated plants will be contrasted to similar plants not fumigated. The plant will contain marker genes on each chromosome and by appropriate genetical techniques the effect of the fluoride on genetic expression will be studied. Tobacco plants infected with tobacco mosaic virus will be fumigated with low fluoride concentrations and via serological techniques the mutation rate of the virus will be determined.

4. PESTICIDES

PROGRESS: Two strains of Drosophila melanogaster were treated with sub-lethal levels of gaseous hydrogen fluoride for six weeks. Egg samples were collected at various times for hatchability determinations. Adults reared from these samples were evaluted for fecundity and fertility. Treatment with HF caused a marked reduction in hatchability and fecundity in the more sensitive strain. Male fertility was depressed but female fertility remained stable over the test period. The reduction of these parameters in the offspring of populations subjected to low levels of atmospheric HF contamination for prolonged periods suggests that HF causes genetic damage.

SUPPORTED BY Texas State Government - Austin

4.0489, DEVELOPMENT AND REFINEMENT OF ANALYTICAL METHODS FOR AGRICULTURAL PRODUCTS

W.L. HOOVER, Texas A & M University System, Agricultural Experiment Sta., *College Station*, *Texas* 77843 (TEX01542)

OBJECTIVE: Develop methods for the more complete, accurate and efficient routine analysis of drugs, feeds, fertilizers and pesticides. Revise and improve methods presently in use for the routine analysis of drugs, feeds, fertilizers and pesticides.

APPROACH: In the performance of routine analyses of agricultural products many problems arise which can best be solved by the development of new methods or the revision of established methods. The research on methods carried out under the auspices of this project will deal with these problems of analysis.

PROGRESS: The development of a method for determining lead in animal and plant tissue was completed. Collaborative samples will be analyzed by this method in several laboratories in the United States. If the rsults of this study are satisfactory, the method will become an official AOAC method. The development of a method for determining boron in fertilizers was completed. This method has been modified for use with plant materials. This new method for determining boron in plants and fertilizers has been accepted as the most reliable method available for determining this element. Work has been completed on testing the Van-Soest methods of analysis for forages. The method for determining cell wall will be used in the Texas Forage Testing Program in 1970 in preference to crude fiber analysis. Work has been started to develop methods of analysis involving specific ion electrodes. Preliminary research indicates that iodide in feeds can be accurately determined by this method with a saving in time of approximately 80% compared to AOAC methods.

SUPPORTED BY Texas State Government - Austin

4.0490, ESTABLISHMENT, MAINTENANCE AND IMPROVEMENT OF TURF GRASSES

G.G. MCBEE, Texas A & M University System, Agricultural Experiment Sta., *College Station*, *Texas* 77843 (TEX00727)

OBJECTIVE: Determine influence of cultural practice on turf establishment. Determine effects of fertilizer materials, frequencies and ratios, on turf quality, growth and development. Determine effect of clipping height, clipping frequency, aeration methods, soil moisture and soil reaction on turf quality, the degree of thatch buildup and related problems. Determine effective ways of preventing initial weed infestation and controlling weeds in established turf. Collect and evaluate species and strains of turf grasses. Develop improved strains of turf grasses. turf grasses.

PROGRESS: Pigment quantitization study showed that total N had no effect on levels of chlorophyll a and b in plant tissue; however, chlorophyll fractions were lower in Common than the other varieties of bermuda. Several selections of St. Augustinegrass show some tolerance and/or resistance to the SAD virus. Residual studies on preemergence herbicides suggest possible use of DCPA and bensulide 4-6 weeks before overseeding. Triazines and diphenamid persisted for at least 12 weeks. Benefin was variable and remains under study. Both Penetrant (DSMO) and energy source (Sucrose) had little effect in enhancing chemical control of Nutsedge. Sandoz showed good control but no selectivity. Arsenical control studies on Dallisgrass indicate 6-8 lbs. a.i./ac. needed for control. Cold tolerance study on St. Augustine indicates late Fall fertilization enhances hardiness and possibly promotes early Spring recovery. Seasonal applications of hormonal-type herbicides on St. Augustine showed 2,4-D and MCPP to be non-toxic up to the 1 lb. a.i./ac. Banvel-D showed some phytotoxicity at the 1 lb. rate. Bromoxynil and ioxynil showed no phytotoxicity up to the 2 lb. a.i./ac. rate. Contact herbicides were the only materials effective in chemical edging. Several bluegrasses, fine fescues, and perennial ryegrasses have excellent qualities for use on golf putting greens.

SUPPORTED BY Texas State Government - Austin

4.0491, METHODS OF CONTROLLING MESQUITE, HUISACHE, LIVE OAK AND OTHER WEEDS ON GRAZING LANDS

H.L. MORTON, Texas A & M University System, U.S.D.A. Crops Research Div., *College Station*, *Texas* 77843 (0710-04-12)

OBJECTIVE: Develop principles and methods of economical control of brush on rangelands and investigate the physiology, anatomy, morphology, and biochemistry of woody plants.

APPROACH: Herbicides and herbicide mixtures are evaluated in greenhouse and field tests for their phytotoxicity to undesirable plants. The influence of environmental variables, such as temperature, light, soil moisture, and relative humidity, on absorption, translocation and metabolism of herbicides by woody plants is measured. Descriptions of surface and internal anatomy of woody plants are made and related to herbicidal effectiveness. Plants and soils are analyzed to determine persistence and degradation of herbicides.

PROGRESS: Mixtures of 2,4,5-T with picloram more effectively control brush of the Texas timberland area than either chemical alone. But mixtures were no more effective on Aloysia lycioides (whitebrush). Spring and fall aerial treatments of picloram and picloram plus 2,4,5-T controlled Quercus virginiana (live oak). Fall treatment controlled Acacia farnesiana (huisache), A. greggii, A. rigidula, whitebrush, Celtis pallida, Colubrina texensis, Opuntia lindheimeri and O. leptocaulis. Diospyrostexana (Texas persimmon), Symphoricarpos orbiculatus, Mahonia trifoliata, Yucca sp., Condalia obtusifolia and Prosopis juliflora (mesquite) were resistant. Application of picloram pellets at several locations and dates controlled live oak, huisache, and Ilex vomitoria but not mesquite. Picloram applied to the root systems of nutrient-grown mesquite and huisache seedlings stimulated ethylene production in both species. Leaves lost their capability for movement. Functional leaves were essential for susceptibility of mesquite and huisache seedlings to picloram applied to roots. Uptake of picloram by potato tuber discs was shown to have a metabolic and physical component. The metabolic component appears to be enzymic in nature. The first change of honey mesquite leaves treated with paraquat is disruption of the plasmalemma followed by rupturing of chloroplasts. The fruit skin or pulp of Texas persimmon contains an inhibitor, consequently seeds were washed free of pulp and dried in a shaded place before seeding.

SUPPORTED BY U.S. Dept. of Agriculture

4.0492, INSECTICIDES AS RELATED TO COTTON INSECT CONTROL

R.L. RIDGWAY, Texas A & M University System, Agricultural Experiment Sta., *College Station*, *Texas* 77843 (TEX01330)

OBJECTIVE: Study physiology of noxious cotton insects as related to control by systemic insecticides. Study metabolism of systemic insecticides (insects and plants). Evaluate effectiveness of candidate systemic chemicals. Discover and develop new and improved methods of insecticide application. Study and develop improved formulations of systemic insecticides. Study the integration of biological and systemic chemical control of cotton insect pests.

APPROACH: Laboratory, greenhouse, field-cage, and field research of a fundamental and semi-applied nature to discover and develop systemic chemicals for control of noxious insects and mites attacking cotton.

PROGRESS: The metabolic fate of the experimental insecticide BAY-93820 in plants was determined. Enzymes responsible for the rapid degradation of organophosphate insecticides in resistant tobacco budworms were isolated. The use of the systemic

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insecticide, aldicarb (Temik), in-furrow at planting and as a sidedressing was combined with diapause control and pheromone traps to demonstrate the technical feasibility of eradicating the boll weevil.

SUPPORTED BY Texas State Government - Austin

4.0493, USE OF LABELLED PESTICIDES FOR STUDYING TERMINAL PESTICIDES RESIDUES IN CERTAIN TROPICAL PRODUCTS

A.J. FEUELL, Tropical Products Institute, *London, England, United Kingdom*

To study the fate of Propoxur and Methyl Bromide in created cocoa and other tropical products, using labelled compounds. The distribution of the pesticides and their breakdown products would be examined and attempts made to identify the nature of the metabolites and terminal residues. The effects of commercial and domestic processing would also be studied where practicable.

SUPPORTED BY Intl. Atomic Energy Agency - Austria

4.0494, LABELLED PESTICIDES FOR STUDIES OF RECOVERY OF PESTICIDE RESIDUES BY SOLVENT EXTRACTION OF SPIKED & AGED CEREAL SAMPLES (ABBREV)

D.C. ABBOTT, U.K. Dept. of Trade & Industry, *London, England, United Kingdom*

To study the comparative efficiency of extraction techniques, using various solvents and procedures, for the recovery of labelled malathion and dichlorvos added to grain.

SUPPORTED BY Intl. Atomic Energy Agency - Austria

4.0495, NATURE AND SIGNIFICANCE OF CYTOLOGICAL, HISTOLOGICAL AND ANATOMICAL EFFECTS OF HERBICIDES

D.L. KINGMAN, Utah State University, Agricultural Experiment Sta., *Logan, Utah* 84321 (0710-04-17(GR))

OBJECTIVE: Determine cytological, histological and anatomical responses of germinating seeds to herbicides propachlor, DCPA, dicamba, EPTC, and pyrazon; the effects of sublethal quantities of these herbicides on young seedlings; and the effect of these herbicides in stripping the histones from DNA in treated plant material.

APPROACH: Both resistant and susceptible plants will be treated at recommended rates and at rates comparable to the residual herbicides often encountered in the field following treatment. Seedlings of crop and weed species will be grown in growth chambers. Seeds will be treated with water solutions and will be examined during the protein rehydration stage and during initial cell elongation and cell division states as growth resumes. Microhistotechniques developed by Gifford and Jensen will be used to determine if herbicides are effective in stripping histones from DNA.

PROGRESS: Oats, green foxtail, squash and onion seedlings were grown in a mixture of DCPA in soil in plastic containers. Anatomical studies of root tips showed that foxtail was the most sensitive species. Root and shoot meristem cells were disoriented and shoot meristem cells hypertrophied. Cell differentiation in treated tissue occurred nearer the root and shoot meristem probably because of stunting of growth. Chloroplasts in treated tissue were enlarged. Treated foxtail has less protein in the shoot and less total nucleic acid in both root and shoot meristems. Squash seeds grown in propachlor treated soil produced plants with thick dark cotyledons and stunted shoot and root growth. Propachlor partially inhibited the breakdown of both lipids and proteins stored in cotyledons. EPTC delayed initial root and coleoptile development of oat seedlings. Bases of the primary roots became necrotic and were greater in the shoot than in the root. Coleoptiles became chlorotic, thickened and were hard and fragile. Young leaves were dark green, water soaked and often failed to emerge. Chloroplasts of pyrazon treated tissues of bean were devoid of starch. Before symptoms appeared, chloroplasts became rounded and swollen. Clumping of the chloroplasts in the lower portion of the palisade parenchyma was common.

SUPPORTED BY U.S. Dept. of Agriculture

4.0496, EFFECT OF SELECTED PESTICIDES ON NUTRITIVE COMPOSITION OF FRUITS AND VEGETABLES

D.K. SALUNKHE, Utah State University, Agricultural Experiment Sta., *Logan, Utah* 84321 (HN09-06-01-GR)

OBJECTIVE: Basic quantitative information, including mechanisms, of alteration by pesticides of essential nutritive components of fruits and vegetables.

APPROACH: Root, legume, cereal and fruit crops are grown in field and greenhouse with commercial soil fumigants and herbicides. Crops are analyzed for carotene, protein levels and patterns, individual amino acids, nitrate and nitrite levels. Known and unknown beneficial effects and mechanisms of nutritive changes are studied.

PROGRESS: Field crops grown in 1969 with triazine herbicides or with soil fumigants have been analyzed. Greenhouse experiments have been conducted on effects of triazines on growth, chemical composition and levels of various enzymes. Mechanisms of nutritive changes are being studied. Carrots grown in 1969 with a soil fumigant (either Telone or Nemagon) had significantly higher contents of total carotene, Beta-carotene and total sugars and lower respiration rates than untreated controls.

SUPPORTED BY U.S. Dept. of Agriculture

4.0497, INFLUENCE OF ENVIRONMENT ON CHEMICAL WEED SUPPRESSION IN CHRISTMAS-TREE PLANTATIONS

T.R. FLANAGAN, Univ. of Vermont, Agricultural Experiment Sta., *Burlington, Vermont* 05401 (VT00010)

OBJECTIVE: Relate organic matter, soil texture, acidity, available soil moisture, and some climatological factors to the effectiveness of herbicides in Christmas tree plantations and to predict safe, efficient, and effective weed and grass control treatments.

APPROACH: Several representative plantation sites will be subjected to herbicidal treatments. Detailed measurements of organic matter, colloidal exchange capacity, soil texture, acidity, and available soil moisture will be correlated with the effectiveness of the treatments and responses of balsam fir and other Christmas trees. Sites will be selected on Christmas-tree growers land and University forest. Herbicides will be restricted to those proven effective.

PROGRESS: Additional treatments in 1969 totalled 319 plots covering 9 species, and 8 herbicides. In addition to the 5 species used in 1968 (Scotch and white pine, Norway spruce, Fraser and balsam fir), herbicide treatments were applied to new plantings of red, white and blue spruce, red pine, and added plantings of balsam and fraser fir and Scotch pine. Herbicides used, alone and in combinations, as both granular and sprays were atrazine, simazine, prometone, paraquat, dalapon, 2,4-D, 2,4,5-T, and silvex. Weed control and tree response ratings were made for all 1968 and 1969 treatments. One test in addition to all previous made on sod, included complete land preparation through tillage. 137 plots, initiated in 1965, were discontinued. Additional soil samples were taken for herbicide residue studies. Observations to date indicate that applications of simazine at twice the label rate, as granules, are continuing to offer grower acceptable weed suppression. No species other than white spruce are susceptible to simazine injury at normal rates. Established balsam fir is susceptible to injury from phenoxys applied as over-sprays. Goldenrod, dandelion, shepherds purse and narrowleaf plantain are simazine resistant. One graduate student is associated with this project.

SUPPORTED BY U.S. Dept. of Agriculture

4.0498, PESTICIDE RESIDUES ON FORAGE RESULTING FROM DRIFT OF DUSTS APPLIED TO ADJACENT ORCHARDS

G.B. MACCOLLOM, Univ. of Vermont, Agricultural Experiment Sta., *Burlington, Vermont* 05401 (VT00124)

4. PESTICIDES

OBJECTIVE: Determine the effect of the following factors on the drift of pesticide residues to forage crops: atmospheric conditions (wind velocity, temperature, humidity and rainfall), equipment used, topographical features of the land, particle size and formulation. Determine the magnitude of such residues at varying distances from the point of application. Define, if possible, the conditions under which drift residues can be avoided or kept at a minimum, and biological effectiveness of orchard pest control materials be maintained.

APPROACH: Recording hygrometer, thermographs and aenemometers will be set out, to obtain records of temperature, humidity and wind velocity during and immediately after application.

PROGRESS: The technique for atmospheric sampling of vaporized toxic material was refined. Parameters for the basic scrubbing system were established. The entire system utilizing a millipore filter, a multiple scrubbing system and an in-line meter is ready for field testing. This system will be compared to a recently published boom-type vapor trapping apparatus. Both systems will be utilized to further pinpoint the factors influencing the dispersal of insecticides in and around orchards. Wind velocities at various locations from the target orchard were correlated with insecticide residues. Residues were obtained at different time intervals and represented that portion of the drift 'falling out' in specific sampling sites at predetermined distances from the target. The residues were analyzed by gas chromatography. Compilation of weather data and correlations with topographical factors and residues are at this time still in preparation. Additional field studies will be necessary to further substantiate these results.

SUPPORTED BY U.S. Dept. of Agriculture

4.0499, THE DEGRADATION OF INSECTICIDES UNDER VERMONT CONDITIONS

B.L. PARKER, Univ. of Vermont, Agricultural Experiment Sta., *Burlington, Vermont* 05401 (VT00169)

OBJECTIVE: Evaluate the presence and persistence of residues of new experimental insecticides, for the control of insects on forage. Determine the effects of these materials on beneficial insects and natural enemies of forage pests in an attempt to develop an integrated control program. Determine the persistence of insecticide residues in forages.

PROGRESS: Field studies to determine the degradation of Gardona on forage were continued. The material was used at 1/4, 1/2 and 3/4 pound rates. Analyses were done by gas chromatography. Under Vermont conditions the toxicant lost 95% of its active ingredient 15 to 20 days after initial treatment. Gardona is commonly used in orchards which in this state are located adjacent to forage lands. Significant residues are still being detected on forage placed in storage in 1967. Although analyses are not completed a slow degradation trend of Tedion on timothy hay in storage is being observed. Insect counts and statistical analyses were completed on experiments conducted to determine suitability of estimating alfalfa weevil larval population by volumetric methods. The procedure is satisfactory for practical usage provided certain parameters are established prior to sampling. Field experiments were conducted to determine the effects of small plot multiple samplings on populations of alfalfa weevil larvae, pupae, and adults. Results of these experiments verified the use of randomized complete block designs with split plots for field insecticide trials on alfalfa. From the standpoint of ease of application, number of different toxicants applied and distance between field trial sites a hand operated gas powered boom sprayer was completely satisfactory.

SUPPORTED BY U.S. Dept. of Agriculture

4.0500, EFFECTS OF GROWTH CONTROLLING CHEMICALS, LIGHT/TEMPERATURE ON GERMINATION/GROWTH/REPRODUCTION

S.C. WIGGANS, Univ. of Vermont, Agricultural Experiment Sta., *Burlington, Vermont* 05401 (VT00101-S)

Approach: Alar and other growth retarding chemicals will be applied to various apple seedling selections and other economically important species to determine their effect on bloom, fruit set, yield, and vegetative growth. Various carbon compounds will be evaluated to determine their effect on herbicide degradation in soil. The growth retardant studies with field grown chrysanthemums will be continued.

Progress: Tomato and muskmelon seedlings were exposed to CCC (2- chloroethyltrimethylammonium chloride) showed significantly earlier flowering and fruit maturation. Tomato plants treated with CCC at the 5-leaf stage and muskmelon plants at the 4-leaf stage had shorter internodes and a 40% increase in stem diameter 6 to 9 days after spraying. Flower formation in both species was advanced from between 5 to 8 days. Fruit set in tomatoes was unaffected and fruit quality seemed normal. Garden chrysanthemums were treated with Alar and gibberellin, maleic hydrazide and phosfon. Single and repeated applications of Alar and maleic hydrazide reduced low temperature injury, however, gibberellin and phosfon applications did not affect plants exposed to low temperatures.

SUPPORTED BY Vermont State Government

4.0501, CONTROL OF UNWANTED PLANT GROWTH IN CROPS, FOREST, WATER AND RECREATIONAL AREAS

S.W. BINGHAM, Virginia Polytechnic Institute, Agricultural Experiment Sta., *Blacksburg, Virginia* 24061 (VA-0200129)

OBJECTIVE: Develop economical programs of weed control associated with Virginia crop production, forest, water and recreational areas.

APPROACH: Entries of herbicide treatments will be evaluated in field tests. More specific responses will be attempted in small field plots, greenhouse and growth chambers. The stage of weed and crop growth will be evaluated as influenced by environmental factors.

PROGRESS: Sod planting of soybeans after small grain was successful with paraquat and various preemergence herbicides. Performance of trifluralin and benefin was reduced 25% when 9 hours elapsed between application and incorporation in soil. Combinations of preplant incorporated and postemergence treatments gave better season- long weed control in peanuts. Picloram and picloram plus 2,4-D gave virtually complete shoot kill of poison ivy. Corn yields were increased by reducing weed competition with linuron plus propachlor, prometryne plus atrazine, SD 15418, butylate plus atrazine, and VCS 438. Fall panicum control was better with a combination of paraquat, atrazine and simazine. Burley and flue cured tobacco returns per acre increased with treatments of diphenamid, benefin, pebulate, butylate, amiben, nitrolin and DCPA. For both crabgrass and annual bluegrass control, two applications of bensulide, benefin or DCPA were required per year. Activated charcoal was effective for reducing hazard from residues of certain preemergence herbicides in the soil. Activated charcoal applied 2 months before herbicides application did not reduce effectiveness for weed control. Nortron was toxic to willow and pyracantha, moderately toxic to 14 other species and 4 species were tolerant. Curl and musk thistles were controlled with 2,4-D in late fall or early spring but poor control resulted with winter treatments.

SUPPORTED BY Virginia State Government

4.0502, ROLE AND FATE OF SURFACTANTS AND OTHER ADDITIVES IN MODIFYING HERBICIDAL ACTION

C.L. FOY, Virginia Polytechnic Institute, Agricultural Experiment Sta., *Blacksburg, Virginia* 24061 (VA-0616082)

OBJECTIVE: Determine patterns of absorption, distribution and metabolic fate of selected herbicides and solution additives (alone and in combination) in higher plants. Evaluate herbicide-additive-plant surface interactions (in vivo and in vitro) that may influence uptake, fate, and activity. Determine sites and mechanisms of the modifying effects of selected additives on herbicidal response.

APPROACH: Previous work suggests that penetration, translocation, metabolic fate, phytotoxicity, selectivity, and/or persistence of herbicides in plants and soils may be altered by chemical additives. Such adjuvants may themselves constitute contaminants in the biosphere. Plants will be treated with selected herbicides and/or diverse additives (e.g. surfactants, phytobland oils, DMSO), and analyzed qualitatively and quantitatively at different levels using radioistopic, chromatographic, and spectrophotometric techniques. Several physico- chemical factors will be investigated to detect possible interactions in the herbicide-additive solution-plant surface complex: surface tension, contact angle, solubilities in aqueous and lipid solvents, hydrophilic- lipophilic balance, pH, ionic charge, chemical complex formation, differential adsorption at interfaces, chemical structure- activity relationships, possible combination of herbicide and surfactant properties in the same molecule (reaction product). Distribution and localization of labeled chemicals in plant tissues will be determined by gross and historadioautography; growth responses and toxicity effects, by bioassay.

PROGRESS: Studies with dalapon--fatty amine reaction products on corn indicate the feasibility of combining desired herbicidal and surfactant properties in the same molecule. Wetting, foliar penetration and translocation of phloem-mobile herbicides 2,4-D, dicamba and picloram were impaired by the hirsute leaf surfaces in Verbascum sp. By radiotracer analysis, Tween 80 surfactant facilitated uptake and mobility slightly; DMSO penetrated poorly and was ineffective as an adjuvant. Certain vegetable oils phytobland petroleum oils, emulsifiers, and their combinations enhanced the selective postemergence activity of atrazine in corn, particularly against grasses for which atrazine alone is ineffective.

SUPPORTED BY U.S. Dept. of Agriculture

4.0503, INSECTS AND MITES ATTACKING APPLES - INSECTICIDES, ACARICIDES, AND APPLICATION TECHNIQUES

C.H. HILL, Winchester Research Laboratory, *Winchester, Virginia* 22601 (VA-0200094)

OBJECTIVE: Evaluation of promising new insecticides and acaricides in control of insects and mites attacking apples, and observations on the continued effectiveness of currently recommended materials. Effects of new insecticides and acaricides, alone and in combination with other standard insecticides and fungicides, on the foliage and fruit. Evaluate spray concentration and application procedure for efficiency in achieving pest control.

APPROACH: New insecticides and acaricides supplied by agricultural chemical industries will be evaluated in apple orchards for biological activity against insects and mites. The evaluation will include detection of any obvious injury to the leaves and fruit, such as loss of leaf chlorophyll, reduction in growth, or russeting of fruit surface. Arrangements will be made with the appropriate industries for residue determinations. Sprays will be applied at 3 concentration rates by using different volumes of spray material in delivering the same amount of toxicant. Ultraviolet light will be used to determine the spray pattern, and photographs to obtain a permanent record.

PROGRESS: Petroleum derivatives (superior spray oils) of either 70 or 60 second viscosity performed equally well in prebloom mite control applications. Chloropropylate, Omite, Galecron, Acarthane, Acarol, Fundal, Lovozal, Plictran and Benlate performed well in prebloom and midseason comparative mite control tests. Morestan appears to be losing effectiveness, at least to some degree. Some additional materials showed promise as acaricides; among these were Torak, Bay 68138, DS 12580, DS 12581, U-27415, TH 367-I, TH-427 I and R 10044. Some leaf injury occurred following applications of TH-367 I and TH 427 I.

SUPPORTED BY Virginia State Government

4.0504, CONTROL OF WEEDS IN BLUEBERRIES AND CRANBERRIES

C.C. DOUGHTY, Washington State University, Agricultural Experiment Sta., *Pullman, Washington* 99163 (WNP01460)

OBJECTIVE: Find methods of controlling the more resistant perennial weeds, especially those growing in high organic soils. Determine the effects of the herbicides employed on growth and production of blueberry and cranberry plants. Determine residues resulting from the use of herbicides on these crops.

APPROACH: Newer, more promising herbicides will be screened for their ability to control the perennial weeds growing in blueberry and cranberry plantings that are resistant to currently recommended herbicides. New herbicide and/or combinations will be tried by randomized block field trials on both high organic and mineral soils to determine the degree of control of weed growth, phytotoxicity to the crop plants and the most susceptible growth stages of the weeds. A study will be made of the difference in herbicidal action of selected materials between mineral and high organic soils using indicator plants to determine toxicity levels. Residue analyses will be made on fruit from plants treated with effective materials.

PROGRESS: Terbacil applications for the control of quackgrass in mature blueberry plantings located on muck, Camas clay loam and Mossy Rock silt loam, at 4 lb and paraquat at 2 lb per acre, were made in October and November, 1968, and February, 1969. Monthly evaluations showed no phytotoxicity to the blueberry plants. No differences in yield were found. The best weed control was obtained from the February application. Paraquat plus terbacil treatments improved weed control in Camas clay loam but not in muck or Mossy Rock silt loam. Terbacil applications in mid-April to blueberries on Camas clay loam produced moderate to severe plant injury from treatments of 2 lb or higher. These results indicate terbacil can be used if applied during the dormant period. Alanap plus 13.1 g (Alanap 8% plus CIPC 5%) treatments were made at 12.5 to 37.5 lb per acre to producing cranberry bogs for the control of buttercup (Ranunculus repens). Ninety per cent control was obtained in both greenhouse and field trials from applications of 12.5 to 15.0 lb. No cranberry phytotoxicity was observed. Ten herbicide combinations were applied to cranberry bogs to control seashore saltgrass (Distichlis spicata). The best control was obtained from a combination of CIPC, simazine and dichlobenil (20 plus 2 plus 4 lb).

SUPPORTED BY Washington State Government - Olympia

4.0505, PHYSIOLOGICAL AND ANATOMICAL REACTIONS IN LEAVES TO ABSCISSION STIMULATING CHEMICALS

F.E. LARSEN, Washington State University, Agricultural Experiment Sta., *Pullman, Washington* 99163 (WNP01931)

OBJECTIVE: Observe penetration and translocation of radioactive defoliants, anatomical differences, and chemical and physical changes in leaves of deciduous, woody plants with high and low susceptibility to abscission stimulating chemicals in order to determine why major differences exist in ease of defoliation.

APPROACH: Leaves with high and low susceptibility to defoliants will be treated with radioactive defoliants to observe penetration and translocation and to see if translocation is important. Anatomical studies will be made and correlated with tracer studies to see what role differences in anatomy may play in the differing response to defoliants. Changes in certain chemical constituents and respiration of untreated and treated leaves before and after treatment will be observed. The plants studied will be of the genera Pyrus, Spiraea, and Weigela.

PROGRESS: The ease of chemically inducing leaf abscission of deciduous, woody plants varies with botanical families, genera, species and varieties. To help explain these differences, chemical, physiological and anatomical variations in test plants are being assessed. Abscission-inducing chemicals used were Ethrel, Bromodine and abscisic acid. Test plants which vary in ease of defoliation are Weigela, apple, and cherry. Studies in progress include the effect of the above chemicals on respiration, leaf anatomy and mineral composition. Promotor-inhibitor levels of the three species were studied through the growing season by paper chromatography and seed bioassay of leaf extracts. Two general rises in leaf respiration occurred about 2 weeks apart in a 5-week study following chemical treatment. The significance of this observation has not been determined, but ease of defoliation of treated species was generally inversely related to rate of respiration. Analysis of 11 minerals 5 weeks after application of chemicals indicates that levels of most minerals are decreased compared to the control in Weigela, but are increased in a majority of cases in apple and cherry. Analysis closer to time of application will be required. Anatomical and promotor- inhibitor studies have not progressed far enough to give meaningful information.

4. PESTICIDES

SUPPORTED BY Washington State Government - Olympia

4.0506, PATHOLOGY AND CONTROL OF ONION WHITE ROT

S.B. LOCKE, Washington State University, Agricultural Experiment Sta., *Pullman, Washington* 99163 (WNP01671)

OBJECTIVE: Develop effective control measures for the white rot disease of onions which will fit into the local cultural practices in the Walla Walla area. Study the survival and germination of the pathogen's sclerotia in the soil. Determine the host range of Sclerotium cepivorum in the genus Allium.

APPROACH: Continue laboratory screening for new fungicides effective against white rot infection, as well as further field plot tests of PCNB and Botran using an improved test design and extending the dosages upward in order to obtain information on margin of safety with respect to phytotoxicity. Also some broadcast applications, as this is the method by which the growers want to use soil fungicides. Greenhouse and lab experiments for effect of soil amendments such as crude chitin, and greenhouse tests of the effect of the non-Allium species on the survival of sclerotia in the soil. Adaptation of the laboratory screening procedure to testing the susceptibility of Allium species.

PROGRESS: Control of white rot was tested on ground highly contaminated with sclerotia. Seven chemical treatments were applied in duplicate (broadcast and rototilled to a depth of 6'). Botran at 30 lbs. active/acre gave unsatisfactory control; at 60 lbs it gave 95% control. Phytotoxicity in terms of reduced bulb yield and bulb size was high at both dosages. Benlate at 15 lbs gave less control of white rot than Botran at 60 lbs, but caused practically no phytotoxicity. Similar soil fungicides, Thiabendazol and Bayer 033172, showed great promise. Fumigants (Methyl Bromine and Chloropicrin) by themselves failed to control infection appreciably. Combinations of Botran at 30 lbs with Methyl Bromine and with Thiram gave excellent control (89-92%). In the former case phytotoxicity was negligible, in the latter it was severe. It is believed that Methyl Bromine and Thiram, being broad-spectrum fungicides were effective in suppressing biological breakdown of Botran in the soil. This hypothesis is supported by Botran residue determinations. In the presence of Methyl Bromine and Thiram effective levels of Botran were maintained in the soil through the period of infection. Spring applications of Botran did not improve control.

SUPPORTED BY Washington State Government - Olympia

4.0507, RESPONSE OF PLANTS TO HERBICIDES

T.J. MUZIK, Washington State University, Agricultural Experiment Sta., *Pullman, Washington* 99163 (WNP01877)

OBJECTIVE: Measure the influence of thiamin on translocation of foliar applied chemicals. Determine the action of temperature on susceptibility of plants to herbicides. Measure relative persistence of 2,4-D, dicamba, (3,6-dichloro-2-methoxybenzoic acid), picloram, (4- amino- 3,5,6-trichloropicolinic acid) and amitrole (3-amino-1,2,4- triazole) in plants under different temperature regimes; and the persistence of picloram in soil.

APPROACH: Plants will be treated with herbicides and exposed to low temperatures for various periods of time following treatment. Visual observations, histological sections, stunting, discoloration and malformation will be used as criteria of damage. Thiamin will be applied together with 2,4-D, bromoxynil and picloran to determine if thiamin enhances herbicide action at low temperatures and in darkness. Radio-autographic techniques will be used to measure rates of translocation.

PROGRESS: Translocation in the phloem of bean plants was blocked by 2,4-D within 12-15 days after 2,4-D was applied to the foliage. The movement of picloram C-14 applied to the foliage, following the 2,4-D treatment, appeared to be blocked in the petiole rather than in the stem as previously thought. Autoradiographs clearly showed that the radioactivity translocated out of the leaf blade and about halfway down the petiole but failed to reach the stem of the bean plant. Anatomical sections through this section of the petiole show an increased cambial activity and cell malformations. These results support the theory that 2,4-D does exert its effect on plants by interfering with translocation. Our results, however, show that although considerable malformation occurs in the stem, the first site of blockage is in the petiole. Pronounced differences in the response of stem and root tissues of Canada thistle and tomato to picloram were found. The stem tissues of tomato underwent severe modification with the development of root initials within 10 days after treatment of the leaves but Canada thistle stem tissue showed very few changes. Root tissue of Canada thistle showed many more modifications than the root tissue of tomato. Picloram appeared to cause proliferation only of the cambium in contrast to 2,4-D which caused proliferation of both cambium and phloem parenchyma.

SUPPORTED BY U.S. Dept. of Agriculture

4.0508, MECHANISM OF ACTION OF PICLORAM AND CACODYLIC ACID

T.J. MUZIK, Washington State University, Agricultural Experiment Sta., *Pullman, Washington* 99163 (WNP01907)

OBJECTIVE: Investigations of the physiological mechanisms of action of picloram, cacodylic acid or other selected herbicides and defoliants. Evaluation of the effects of temperature on the absorption and translocation of chemicals and subsequent plant responses including histological changes in the tissues. Evaluation of absorption, translocation, accumulation and breakdown in plant tissue and organs of compounds, with particular emphasis on accumulation and breakdown in plant tissue.

APPROACH: Plants will be grown under controlled environmental conditions. Picloram and cacodylic acid will be applied and effects on growth and differentiation investigated by histological sections and autoradiographs especially in the abscission zone.

PROGRESS: Controlled environment studies with Ligustrum and Coleus were conducted to determine influence of temperature and humidity on the abscission induced by cacodylic acid. Abscission was found to be almost completely suppressed by 13 C and was most rapid at the highest temperature examined (36 C). Very high concentrations of cacodylic acid prevented leaf fall. Studies with petiole explants showed that cacodylic acid, amitrole and IAA had little effect on abscission in Ligustrum and Coleus. No stimulation of abscission was noted. In beans, however, all 3 compounds used (cacodylic acid, amitrole, IAA) stimulated abscission at low concentrations. No evidence was obtained for the 2 stage reaction of abscission with any compound tested in either 3 species examined. Influence of temperature on the uptake of cacodylic acid in beans was also examined by a bioassay method. Experiments with picloram have examined persistence, volatility, translocation and its histological effects. Persistence of picloram has been found to be much greater in plants grown in soil than in plants grown in frequently changed solution. This is caused by a leaching of picloram from the roots into the nutrient solution. Translocation of picloram was found to be greater at 21 C than at 15 C. It appeared that translocation out of the foliage was much more influenced by temperature than translocation out of the roots.

SUPPORTED BY Washington State Government - Olympia

4.0509, RESPONSE OF PLANTS AND PLANT COMMUNITIES TO SUSTAINED USE OF HERBICIDES

T.J. MUZIK, Washington State University, Agricultural Experiment Sta., *Pullman, Washington* 99163 (WNP02000)

OBJECTIVE: Determine effects of repetitive application or persistent pollutional levels of herbicides on plant communities. Determine effects of repetitive application or persistent pollutional levels of herbicides on the structure, chemical composition, and function of individual species of the plant community.

APPROACH: Solutions of herbicides of known concentration will be applied to roots of intact plants and to isolated roots for various intervals of time under controlled environmental conditions. Absorption of herbicides from various kinds of soil will be measured at later stages of study. By the use of radioactively labeled herbicides and by appropriate histological techniques, data will be obtained on the pathways of entry and translocation in plants and involvement of cell walls, membranes, and protoplasts in herbicide distribution within plants. Herbicides studied will include the auxinlike compounds, 2,4-D, picloram, and dicamba, and the substituted ureas and triazines. Wheat and peas will be used as plant materials.

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PROGRESS: Studies were conducted on the ability of certain plants to remove significant quantities of herbicide from treated soils, as a possible means of detoxification of the soils. Soils treated with 2,4- D, 2,4,5-T, dicamba, picloram, simazine, diuron and monuron were planted with corn, wheat, barley, peas, tomatoes and beans. The plants were removed and the soil replanted with oats and peas as indicators of soil residue. Corn appeared to reduce simazine, 2,4-D, dicamba, and 2,4,5-T to levels at which the indicator plants grew as well as in untreated soil. Other crop species were much less effective. Carbohydrate accumulation was observed by histochemical staining techniques in the phloem and proliferating tissue of plants treated with picloram.

SUPPORTED BY U.S. Dept. of Agriculture

4.0510, CHEMICAL WEED CONTROL IN ORNAMENTALS IN WESTERN WASHINGTON

G.F. RYAN, Washington State University, Agricultural Experiment Sta., *Pullman, Washington* 99163 (WNP01423)

OBJECTIVE: Determine herbicidal tolerances of selected ornamental plants. The time, rate and method of herbicidal application for the control of certain weeds. Obtain cost of control data.

APPROACH: Propagate different species and varieties of broadleaved and coniferous evergreen shrubs, deciduous flowering shrubs, herbaceous perennial and annual flowers for replicated, randomized field experiments on different soil types. Apply annual weed seeds representative of those growing in this area in the plots to insure adequate weed infestation. Treatments will include different forms, rates, methods and time of application of promising herbicides applied singly and in selected combination and will be compared to untreated plots.

PROGRESS: Four kinds of coniferous evergreen shrubs appeared tolerant of simazine, dichlobenil and norea, but Mugo pine (Pinus mugo) seedlings in Puyallup sandy loam soil were injured by dichlobenil at 4 or 6 lb/A. Atrazine gave residual weed control comparable to simazine and apparently did not cause injury to the conifers. It has the advantage that it can be used for postemergence control of small weeds. Some broadleaf species were reduced in size or showed other symptoms of injury from atrazine. Delaying herbicide application for a few weeks after planting is suggested for many herbicides to reduce the possibility of plant injury. Use of granular trifluralin immediately after planting, followed a month later by dichlobenil, showed some promise as a method of maintaining weed control without cultivation and hand labor. Simazine and norea appeared to be the most promising herbicides in container-grown nursery stock. Failure to control common groundsel (Senecio vulgaris) in a nursery where simazine or atrazine had been used once or twice annually for 10 years was shown to be due to the development of a strain with a high degree of resistance to those two herbicides. Dichlobenil and norea both controlled the triazine resistant form of this weed, and they can be used in place of simazine in most nursery applications.

SUPPORTED BY Washington State Government - Olympia

4.0511, ANNUAL AND PERENNIAL WEED CONTROL IN THE WHEAT GROWING AREA OF EASTERN WASHINGTON

D.G. SWAN, Washington State University, Agricultural Experiment Sta., *Pullman, Washington* 99163 (WNP01888)

OBJECTIVE: Develop new or improved chemical methods of selective and non-selective control of weeds in wheat and crops grown in rotation with wheat in eastern Washington; the economic importance of specific annual weeds such as blue mustard on wheat production and evaluate the economic factors related to their control; the influence of soil moisture, temperature, precipitation, and soil type on herbicide performance, and measure the soil residue properties of diuron, bromacil, and picloram and the effect on subsequent crops.

APPROACH: Screen experimental compounds and conduct intensive trials with herbicides which have or probably will be recommended. Obtain soil moisture, temperature, precipitation, and soil type data. Control weed populations by hand and with chemicals to determine effect on wheat yield.

PROGRESS: Adaptation weed control trials in winter wheat: Eight herbicide treatments, diuron, linuron, GS-14260, bromoxynil, bromoxynil plus MCPA, dicamba plus MCPA, dicamba plus 2,4-D and 2,4-D were applied at five locations in eastern Washington. Soils ranged from sandy loam (67% sand, 0.7% O.M., 8 meq. CEC) to silt loam (17% sand, 4.6% O.M., 23 meq. CEC). Precipitation ranged from 8 to 21 inches per year. Weed control was from 50 to 90%. Yields from all treated plots were less than from the weed free check (average of five locations). Diuron, linuron, and GS-14260 caused yield reductions only on sandy loam soil. Soil type was not a factor for foliage applied materials. These decreases were caused by competition from uncontrolled weeds, soil active herbicides applied to sandy soils (absorbed by crop roots), injury from foliar absorption and adverse weather conditons. Blue mustard competition study: Wheat yields from herbicide treated and hand weeded plots were compared in two fields. Three controlled blue mustard populations of 1, 3, and 9 plants per square foot were maintained. Plots treated with diuron and bromoxynil yielded similar to the weed free check. Yields from the spring weeded check and 2,4-D treated plots were significantly less than from the weed free check. At one location, as weed population increased, wheat yield decreased. More than 50% of the competitive effect occurred between November and March.

SUPPORTED BY Washington State Government - Olympia

4.0512, EFFECTS OF HERBICIDES ON TREE FRUITS AND SMALL FRUITS

O.E. SCHUBERT, West Va. University, Agricultural Experiment Sta., *Morgantown, West Virginia* 26506 (WVA00116)

OBJECTIVE: Investigate effect of herbicides on horticultural crops and their use to control weeds; methods and techniques for more efficient and safe use of herbicides.

APPROACH: Greenhouse and laboratory studies on effects of herbicides on growth and reproduction of horticultural crops such as tomatoes, apples and azaleas and on weeds such as horsenettle, bindweed and mugwort will be conducted.

PROGRESS: In applications of herbicides to Golden Delicious apple trees for past two seasons, terbacil has given the best season-long weed control, especially in areas where barnyardgrass, quackgrass and fall panicum are abundant. In the greenhouse strawberry runner plants were smaller when grown in soil previously treated with several herbicides including all combinations containing diphenamid at 8 lb/A, except diphenamid plus EPTC. Pretransplant incorporated and posttransplant broadcast applications of diphenamid on tomatoes gave satisfactory weed control from June 26 to October 20 where the fields were irrigated within one day after treatment. Apple trees treated with herbicides within the limb spread produced larger apples and greater vegetative growth than non-treated trees. During years of insufficient rainfall during the first six months, the larger the area treated the larger the response from herbicides. Mouse activity around the base of the tree apparently can be controlled by eliminating weeds within a 3-foot diameter area about the tree trunk. December applications of terbacil, simazine and diuron are as effective in vegetation control as March or April applications. The combination of 30 lbs Ammate X plus 2 quarts low volatile oil base 2,4-D plus 10% Orchex N-795 oil appears to be more effective in the control of poison ivy than either 2,4-D or Ammate X by themselves.

SUPPORTED BY U.S. Dept. of Agriculture

4.0513, CONTROL OF WEEDS FOR PASTURE AND FORAGE PRODUCTION

C. VEATCH, West Va. University, Agricultural Experiment Sta., *Morgantown, West Virginia* 26506 (WVA00169)

OBJECTIVE: Determine the effectiveness of herbicides when applied: as soil treatments prior to seeding of forage crops, early post- emergence treatment of forage crop seedings, in established meadows and pastures. Determine the effect of herbicides applied to cultivated crops in the rotation on weed control and subsequent establishment of small grain and forage crops.

APPROACH: Herbicides will be applied before seeding, after seeding and at an early seedlign growth stage of alfalfa or alfalfa grass mixtures. The effectiveness of weed control will be recorded as well as any stunting of the alfalfa or grass. These treated plots will be compared with alfalfa seeded with oats as a companion crop. Yields will be taken if the results indicate measurable differences that can be attributed to weed control. Herbicides will be applied to corn with the object of determining any residual effect on the following crops of small grain or forages.

PROGRESS: The use of herbicides in controlling weeds in corn without leaving residues toxic to following crops was investigated at 4 locations. No serious residue problems were encountered except where atrazine was used at high rates (4 lb. per acre) to control quackgrass. Combinations of 1 lb. of atrazine with alachlor or linuron gave good control of fall grasses. Two brush covered pasture areas were sprayed with various combinations of herbicides with a power sprayer. Best results were secured with combinations containing picloram. Previous work indicates that the back-pack mist blower, if properly used, is a more effective means of applying 2, 4, 5-T to brush than either power sprayers or aerial spraying. Brush control is one essential step in pasture management if we are going to increase pasture production.

SUPPORTED BY U.S. Dept. of Agriculture

4.0514, BIONOMICS OF THE CEREAL LEAF BEETLE

J.W. APPLE, Univ. of Wisconsin, Agricultural Experiment Sta., *Madison, Wisconsin* (WIS01259)

OBJECTIVE: Study distribution and factors responsible for the dispersal of the pest. Determine the life history of the cereal leaf beetle under natural conditions. Determine the response of the insect to simulated environmental conditions. Evaluate the significance of infestations on host plants. Determine means of control. Establish integrated life tables which will provide mortality data and predictive indices.

APPROACH: Plant systemic insecticides will be screened for phytotoxic effects when used as preplanting, planting and postplanting treatments on small grains.

PROGRESS: The four summers spent in southwestern Michigan provided Wisconsin entomologists with much first-hand information on the biology of this insect and the damage it causes. Eggs were found as early as April 28 on canary grass but were not common on oats until May 14 (1964 and 1965). Larvae were first noted on oats May 11 (1965) but maximum numbers (greatest 12.6/stem) were not reached until June 5-15. Pupae in the soil had a greater survival (93.4%) in moist soil than in dry soil (78.4%). On the average, only 25.4% of the insects passed from the larval, through the pupal stage and emerged as adults. The greatest attrition (71.9% mortality) occurred among larvae attempting to produce pupal cells within the soil. There was 16.8% mortality within pupal cells. Adults were first noted on June 10 (peak June 28) in southwestern Michigan and they began entering hibernation niches as early as June 24. However, there was evidence that some moved to other sites as late as October. A larval population of 10.4 per oat stem in 1967 reduced grain yield by 32.4 bushels/acre or 48.8%. This amounted to 4.7% reduction per larva per stem. Oat straw weight was reduced 2.1% per larva per stem.

SUPPORTED BY U.S. Dept. of Agriculture

4.0515, MACHINES FOR ESTABLISHMENT AND MANAGEMENT OF CROPS AND PASTURE

G.P. BARRINGTON, Univ. of Wisconsin, Agricultural Experiment Sta., *Madison, Wisconsin* (WIS00556)

OBJECTIVE: Study methods of seed placement and soil compaction which will produce optimum stands of forages from minimum rates of seeding including proper depth and rate of seeding, fertilizer placement and soil firmness and compaction. Test effectiveness of various available seeding machines and improve design of such machines. Seed grasses and legumes at precise depths of 1/2-inch increments of 0 to 2 1/2 inches with specially designed hand-seeding equipment.

APPROACH: Existing farm machinery, in many instances, does not adequately plant grass seed since rates are difficult to control and depths of seedings are not always suitable. Some investigation of method of seeding with field machines will be continued, and placement of seed, placement of fertilizer and compaction will be investigated to determine effect of each on stand and yield. Additional data is needed in some areas and verification of previous results is also necessary. Stand count and yield data will be obtained.

PROGRESS: Plant counts obtained spring and fall; carbohydrate in roots made on fall counts; forage yields and quality measured on 3 harvests during 1969 on Vernal alfalfa stands established at 4 pound increments up to 32 pounds per acre in spring 1968. Vernal and Saranac alfalfa established at 6 pound increments up to 36 pounds per acre, spring 1969. Stand counts obtained during June and October, 1969. Carbohydrate reserves measured on fall-counted roots. Two harvests for forage yield and quality obtained on these. Evaluation of oats c.c. as forage and grain compared to other methods of establishing alfalfas for the second year. Dry matter, crude protein and DDM measured in oats and alfalfa seed year and dry matter of alfalfa yields in second year. Effect of oats on alfalfa establishment noted. Alfalfa also established with herbicides. Dalapon used to establish alfalfa and birdsfoot trefoil. Persistence of chemical studied; residue samples taken at 4, 6, 8, 10 and 12 weeks. Effect of chemical on establishment and magnitude of residue at collection dates given in station report. Three legumes not producing bloat in animals seeded without companion crop. Established with Eptam, Balan and 2,4-DB and compared with alfalfa. Seeded in pure stands. Success of seedlings and comparative use by beef animals reported in state report.

SUPPORTED BY Wisconsin State Government - Madison

4.0516, METHODS AND MATERIALS FOR WEED CONTROL IN FRUIT AND VEGETABLE CROPS

L. BINNING, Univ. of Wisconsin, Agricultural Experiment Sta., *Madison, Wisconsin* (WIS01205)

OBJECTIVE: Evaluate new herbicides for incorporation in weed control programs. Devise and evaluate methods for utilization of cultural and ecological factors to assist weed control programs. Determine the control efficiency and crop tolerance of formulations, mixtures, and methods of application for new and established herbicides. Provide for the safe and responsible use of the materials available for the production of horticultural crops.

APPROACH: Field and laboratory studies will be conducted in replicated trials such that statistical evaluations of results can be made. Field trials will be conducted using appropriate methods and rates of materials. Evaluations will consist of weed ratings, counts, species controlled, crop tolerance and injury, change in color, grade, other factors of economic importance and yield. Interpretation of results will be made in relation to soil, climatic and cultural factors.

PROGRESS: Lima Beans - Control of black nightshade was obtained from CIPC, amiben, and combinations of amiben plus Lasso, Ramrod, and Randox. Snapbeans - Eptam and Vernam were the most effective materials. Maloran, TH-469, and Treflan caused some injury as indicated by yield reduction. Cucumbers - Amiben M. E. was most effective material. NPA was also effective where rain followed application. Planavin was tested extensively for possible injury to cucumbers and found to be safe. Beets - Various herbicides evaluated and from this study and previous results Ro-Neet has been recommended for the coming season. Other materials of interest are post-emergence application of Pyramin and Betanal. Cranberries - A rate of 12 lb./A of 2 chloro-2'6'-diethyl-N- (methoxymethyl) acetanilide (Lasso) applied in mid-June showed promise for Carex chorodorhiza control. Strawberries - Preforan (p-nitrophenyl- 2-nitro-4-(trifluoromethyl phenyl ether) showed good post emergence value against germinating annual weed seedings. The herbicide 2-chloro- 2',6'-diethyl-N-(methoxymethyl) acetanilide (Lasso), was tolerated by strawberries at rates to at least 4 lb./A.

SUPPORTED BY U.S. Dept. of Agriculture

4.0517, FERTILITY OF FOREST NURSERY SOILS

J.R. BOYLE, Univ. of Wisconsin, Agricultural Experiment Sta., *Madison, Wisconsin* (WIS00549)

OBJECTIVE: Observation of the supply and ratio of nutrients in nursery soils, correction of nutrient deficiencies by application of fertilizer broadcasts, catch crops, composts, nutrient solutions and liquid humates.

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APPROACH: The results of fertilizer and biocidic treatments are evaluated on the basis of anatomical and physiological analyses of seedlings providing an index of the survival and growth potential of planting stock.

PROGRESS: Foliar analyses of red pine seedlings disclosed that repeated application of Manzate, a manganese containing fungicide controlling needle cast, imparted to trees an abnormally high concentration of manganese, also that of aluminum. Both elements are constituents of toxic compounds and accumulation in plant tissues may be responsible for recently recorded growth immobilization of field planted trees. Correction of the internal nutrient balance of stock is sought by application of lime, alkali-forming fertilizers, and a search for means of Lophodermium control eliminating the use of manganous fungicides. Some of the recently introduced biocides stimulate the growth of crowns of nursery stock, but depress the development of root systems. In extreme cases, reforestation material exhibits an extremely high top-root ratio, abnormal degree of succulence, and a very low adsorbing surface of roots, properties which lower the ability of trees to withstand drought, frost, snow press, and attack of parasitic organisms. Improvement in top-root ratio and the internal structure of seedlings was obtained by a reduction in the release of available nitrogen through combined use of Sphagnum peat and a solution of aluminum sulfate, and application of potash and phosphate fertilizers.

SUPPORTED BY Wisconsin State Government - Madison

4.0518, CHEMICAL CONTROL OF AQUATIC WEED NUISANCES

D.R. KEENEY, Univ. of Wisconsin, Agricultural Experiment Sta., *Madison, Wisconsin* (WIS01600)

OBJECTIVE: Evaluate aquatic herbicides in laboratory, growth chamber and natural environments with respect to herbicide specificity and degradability and the toxicity of the parent compounds and their degradation products in aquatic systems, increasing herbicide effectiveness by developing slow-release formulations, and effect of weed control on nutrient changes in lakes.

APPROACH: Available organic herbicides will be evaluated for their specificity and activity against common Wisconsin aquatic weeds, and the toxicity of their degradation products determined. Attempts will be made to develop controlled release formulations of promising aquatic herbicides. Artificial impoundments will be established in growth chambers and the biotron, and effects of weed kill on the nutrient status of the water and sediment will be elucidated. The principles developed in the above investigations will be tested in weed infested Wisconsin Lakes in cooperation with the Wisconsin Department of Natural Resources.

PROGRESS: Release of N and P from entothall-treated watermilfoil (Myriophyllum spicatum L.) was investigated using model sediment-water systems in the laboratory. The effect of sediment, sediment type, and aeration were included in the investigation. Without aeration, plant decomposition decreased the dissolved oxygen content markedly. The decomposing plants lost up to 80% of their weight in 10 weeks. The nitrogen percentage in the plant residue more than doubled while percent P decreased by about 20% in 6 weeks. Up to 70% of the P in the weeds was released by 6 weeks while about 50% of the N had been lost. More rapid release of N and P occurred in the presence of sediment than in lake water alone, and under aerated than non-aerated conditions.

SUPPORTED BY U.S. Dept. of Agriculture

4.0519, METABOLIC ANTITRANSPIRANTS ON TREES

T.T. KOZLOWSKI, Univ. of Wisconsin, Agricultural Experiment Sta., *Madison, Wisconsin* (WIS01350)

OBJECTIVE: Determine most suitable antitranspirants and methods of application to forest trees; evaluate antitranspirant toxicity; determine responses of species with small stomates and those with large stomates to antitranspirants; evaluate phytotoxicity of spreading agents; determine if monomolecular layers can be translocated and deposited in mesophyll tissues and thereby reduce transpiration.

APPROACH: Apply promising antitranspirants as leaf dips, seedling dips, and sprays. Determine transpiration decline curves. Determine stomatal aperture with porometers, water potential with psychrometry or the Shardakov technique. Development of internal water stresses will be monitored continuously by measuring shrinkage of leaves, fruits, and stems. Phytotoxicity will be evaluated by studying injury to cells and by effects on processes (e.g., photosynthesis, respiration, etc.).

PROGRESS: Diurnal fluctuations in leaf thickness of Morello Cherry were related to photoperiodic regime and vapor pressure deficit (VPD) of the air. Leaf thickness decreased in the light and increased during dark periods, with fluctuations in VPD influencing the magnitude of leaf thickness changes. When daily changes in VPD were minimized, leaves still showed a consistent pattern of skrinkage during the day and expansion at night. Correlation between photoperiodic regime, VPD of the air, and leaf thickness was better when soil moisture availability $ was high. Effect of antitranspirant Foligard on water balance of transplanted Populus deltoides trees was determined. Leaf water potential was lower for trees sprayed with 25% Foligard than for unsprayed. Leaves on unsprayed and transplanted trees were most severely wilted; those on sprayed and transplanted trees less wilted; leaves on controls (not transplanted or sprayed) were unwilted. Balled trees survived transplanting in midsummer and bare rooted trees did not. Shoots of Ulmus americana seedlings were dipped in 25% Foligard or Adol 52 (n - hexadecanol) Foligard reduced transpiration appreciably and did not visibly injure seedlings. Adol, used with acetone, injured seedlings, may be effective if it can be dissolved in a polar, non toxic solvent. Adol decreased transpiration in pines, without clear cut patterns of phytotoxicity. Toxicity varies with wetting agents.

SUPPORTED BY U.S. Dept. of Agriculture

4.0520, CHEMICAL CONTROL OF PERENNIAL BROADLEAVED WEEDS IN ALFALFA

C.A. KUST, Univ. of Wisconsin, Agricultural Experiment Sta., *Madison, Wisconsin* (WIS01203)

OBJECTIVE: Recommend specific herbicides for perennial weed control in alfalfa so that the quality and yield of forage per acre will be increased.

APPROACH: The work will involve the collection of additional data on yields of alfalfa from fields treated with four herbicides that have been effective in past tests. The determination of levels of herbicide residues present in alfalfa forage at time of harvest.

PROGRESS: Field studies revealed that 4-month old alfalfa seedlings, established without a small grain companion crop or with a grain companion crop in early May, tolerated herbicides applied in mid- September at rates sufficient to obtain fair to complete control of seedling plants of white cockle, yellow rocket, and hoary alyssum. The chemicals also controlled volunteer oat seedlings, which infest alfalfa stands after the grain companion crop is harvested at maturity. At high rates of herbicide application, alfalfa was injured and the injury seemed related to decreased cold resistance of the alfalfa plants.

SUPPORTED BY U.S. Dept. of Agriculture

4.0521, EFFECT OF PHOSPHORUS INSECTICIDES ON QUALITY OF ALFALFA HAY

C.C. BURKHARDT, Univ. of Wyoming, Agricultural Experiment Sta., *Laramie, Wyoming* 82071 (WYO00920)

Objective: Determine effect of phosphate insecticides on the dry weight, nitrogen phosphorus and carbohydrate composition of treated alfalfa plants.

Approach: Alfalfa plants will be treated with seven different phosphorus insecticides. These plants will be harvested and analyzed at 1, 2, 3 and 4 weeks after treatment for dry matter, nitrogen, phosphorus and carbohydrate composition.

Progress: Split plot statistical analysis of 1966 field samples showed no significant differences between any of the treatment means for ash, phosphorus, crude fiber, crude protein and ether extract. In greenhouse (1967) plants made from alfalfa cuttings were treated with malathion, diazinon, systox and thimet at 0, 0.008, 5 and 125 ppm and maintained under extreme high temperatures. With increase in insecticide concentration, malathion exhibited a corresponding increase in TAC (total available carbohydrates); whereas, thimet, diazinon and systox showed a decrease. Malathion, thimet and systox caused a linear decrease in percent total nitrogen. Diazinon, however, resulted in an irregular increase in percent nitrogen. Mean height per plant dropped linearly for malathion but followed irregular pattern for thimet, diazinon and systox. Mean dry weight per plant although generally greater at each treatment concentration of each of the four insecticides relative to controls, followed an irregular pattern. Under usual greenhouse conditions, four groups of plants were treated with malathion, thimet, diazinon and systox at 0, 5, 25 and 125 ppm. Dry weight per plant for each insecticide increased over controls. Chemical analysis not completed.

SUPPORTED BY U.S. Dept. of Agriculture

4.0522, EFFECT OF PESTICIDES ON MORPHOLOGY AND STRUCTURE OF LACTIC ACID ORGANISMS

D.D. DEANE, Univ. of Wyoming, Agricultural Experiment Sta., *Laramie, Wyoming* 82071 (WYO09-0069)

OBJECTIVE: Study effect of agricultural pesticides on the morphology of selected lactic acid bacteria. Study influence of growth conditions on effect of such pesticides. Determine nature of any change in cell ultrastructure associated with morphological changes observed.

APPROACH: Several species of lactic acid bacteria will be screened to determine those whose morphology is altered followed repeated subculturing in media containing pesticides and/or insecticides available to the dairy industry. Growth conditions will be changed to study the importance of environment on the effect of such compounds. Those organisms showing changes in morphology will be examined by electron microscopy by a procedure based on the methods of Kellenberger, et al. The method involves harvesting the cells by centrifugation, fixing, staining, imbedding in an Epoxy preparation then cutting sections by means of a diamond or glass knife before examining with an RCA EMU3-G electron microscope operated at 100 KV.

PROGRESS: Eugon, trypticase soy and tomato juice broth, with and without added pesticides, were used as a growth medium for six lactic culture organisms. The streptococci, namely S. cremoris, S. diacetilactis, S. lactis and S. thermophilus, tended to form longer chains of cells in tomato juice broth. Adding 100 ppm malathion or 500 ppm trichlorfon to the media produced no consistent changes in morphology of most of these streptococci although S. cremoris grown in tomato juice broth plus 500 ppm trichlorfon appeared as smaller cells. Most strains of Lactobacillus casei and Lactobacillus bulgaricus showed increased chain formation when grown in tomato juice broth. Trichlorfon or ciodrin at a concentration of 500 ppm in tomato juice broth induced some strains of Lactobacillus bulgaricus to form even longer chains. The pesticide, sevin, at a concentration of 50-100 ppm in tomato juice broth, produced increased chaining with one strain of L. bulgaricus while a concentration of 250 ppm of sevin inhibited, to some degree, all strains of lactobacilli tested. Two strains of L. casei showed morphological changes when grown in tomato juice broth to which 100 ppm malathion had been added. Chains of cells 50-70 mu long were found with several of the lactobacilli and 'structures' up to 20-30 mu long with no visible septae observed.

SUPPORTED BY U.S. Dept. of Agriculture

4.0523, EVALUATION OF THE EFFECT OF PESTICIDES ON THE LIPID CONTENT OF RUMEN BACTERIA

J.E. KUNSMAN, Univ. of Wyoming, Agricultural Experiment Sta., *Laramie, Wyoming* 82071 (WYO10-0069)

OBJECTIVE: Evaluate the effect of pesticides on rumen bacteria.

APPROACH: Two or three pure cultures of typical rumen bacteria will be secured and maintained on a Rumen Fluid Glucose Cellubiose Agar Media. A large batch (6L) will be prepared using a chemically defined basal media, in chloroformmethanol (2:1). Separation of the partially purified lipid into polar and nonpolar classes will be achieved by silicic acid column chromatography. Structures of certain compounds will be confirmed by hydrolysis and identification of the component parts and by use of infrared spectroscopy. Pesticides will be analyzed by gas liquid chromatography.

PROGRESS: Ten pure cultures of typical rumen bacteria have been acquired and successfully grown in a chemically defined media. Growth curves for each species have been drawn. Continuing studies include subjecting the cultures to various concentrations of pesticides and evaluating their growth. In addition the effect of the pesticide on the fatty acid pattern will be evaluated.

SUPPORTED BY U.S. Dept. of Agriculture

4.0524, HERBICIDAL WEED CONTROL IN ALFALFA IN WYOMING

G.A. LEE, Univ. of Wyoming, Agricultural Experiment Sta., *Laramie, Wyoming* 82071 (WYO00949)

OBJECTIVE: Determine the feasibility of the use of various classes of herbicides in establishing alfalfa and their use for weed control in established stands under Wyoming conditions. Determine the longevity of control and effect of herbicidal residues upon the establishment of subsequent crops.

APPROACH: Several herbicides at various rates will be applied, in a completely randomized block design, pre-emergent to new alfalfa seedings, and post-emergent to established stands of alfalfa. Percent weed control and percent stand of alfalfa will be determined by counts and clipping measurements. Tonnage yields will be determined by clipping and weighing green tops. Plots will be established in three Wyoming locations. Longevity of weed control will be determined by taking measurements described above for two to three years. The plots will then be used to determine the herbicidal effect on various crops commonly grown in Wyoming. Toxicity to crops will be determined visually on a comparative scale.

PROGRESS: Research and demonstration plots were established during the 1969 growing season to measure the effect of various herbicides on percent weed control, alfalfa yields and protein levels in alfalfa hay. Dormant alfalfa treatments were made in March and April. Excellent weed control was obtained with terbacil, simazine, atrazine, GS-14254 and RP- 11561. Some chlorosis was observed on alfalfa plants treated with simazine. Yield of alfalfa was significantly increased on dryland locations where good to excellent weed control was obtained. When compared to the nontreated check, many herbicides increased the protein levels 1.5-2.5 percent. Simazine and GS-14254 will give residual weed control the following year.

SUPPORTED BY Wyoming State Government - Cheyenne

4.0525, WEED CONTROL IN SUGAR BEETS

G.A. LEE, Univ. of Wyoming, Agricultural Experiment Sta., *Laramie, Wyoming* 82071 (WYO17-0069)

OBJECTIVE: Evaluate single and combinations of herbicides as preplant, postemergence and complementary (preplant plus postemergence) treatments. Determine economic significance of herbicide uses in sugar beet weed control.

APPROACH: Phytotoxic response of weeds and sugar beets to treatments will be made by actual population counts, crop yields and sucrose content of beet roots. Records of cost for herbicides, equipment and labor will be kept and comparisons made.

PROGRESS: Greenhouse studies confirm that phenmedipham phytotoxic activity is dependent on temperature at the time of and following application. At 50F, most weed species were not satisfactorily controlled. Weed seedlings died rapidly when treated at 80F; however, sugar beet plants were adversely effected. Sugar beets were not affected by phenmedipham at 65F and weed species died quite rapidly. Phenmedipham as a postemergence treatment does not result in satisfactory control of redroot pigweed under field conditions. When cycloate was applied as a preplant treatment at a half rate, phenmedipham as a postemergence treatment effectively controlled the remaining redroot pigweed as well as other weed species present. BASF-2430 plus phenmedipham and Schering-475 resulted in excellent postemergence control of all species present. No new preplant herbicide in the screening trials performed as well as the standard cycloate treatment. Complementary preplant plus postemergence

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treatments resulted in season-long weed control at the Torrington Agriculture Substation.

SUPPORTED BY U.S. Dept. of Agriculture

4.0526, RESPONSE OF PLANTS AND PLANT COMMUNITIES TO SUSTAINED USE OF HERBICIDES

G.A. LEE, Univ. of Wyoming, Agricultural Experiment Sta., *Laramie, Wyoming* 82071 (WYO33-0070)

OBJECTIVE: Determine effects of repetitive application or persistent pollutional levels of herbicides on plant communities.

APPROACH: Evaluate the effects of a single application of herbicide made at the beginning of the project upon crops and weeds over a five-year period. Single herbicide applications of picloram, dicamba, and 2,4-D will be made on two types of soils. Barley, dry beans, peas, and sugar beets will be grown on these soils. Herbicidal residues will be determined in harvested crops and in the soil by bioassay and chemical analysis.

PROGRESS: Research was initiated in 1969. Picloram at 1/8 and 1/16 lb/A, dicamba at 1.0 lb/A and 2,4-D at 2.0 lb/A were applied to a sandy loam soil. Barley, alfalfa, field beans, sugar beets and peas were planted in the area treated with each herbicide. All herbicides severely injured the broadleaved crops. Barley grew to normal height in the 2,4-D and picloram treatments. However, dicamba at 1.0 lb/A caused moderate to severe stunting and malformations on the barley plants. The same crops will be grown in the plots without retreatment to determine residual effect on various species.

SUPPORTED BY U.S. Dept. of Agriculture

4.0527, RESPONSE OF PLANTS AND PLANT COMMUNITIES TO SUSTAINED USE OF HERBICIDES

R.J. MCCOLLOCH, Univ. of Wyoming, Agricultural Experiment Sta., *Laramie, Wyoming* 82071 (WYO29-0070)

OBJECTIVE: Determine effects of repetitive application of persistent pollutional levels of herbicides on the structure, chemical composition, and function of individual species of the plant community.

APPROACH: To determine effects of residual and herbicidal levels of selected herbicides on plant cell wall composition including pectic substances, cell membrane lipids and pectic enzymes.

PROGRESS: Work on W-108 has just been initiated in this Division. The final report on W-52 entitled 'Cytological, Physiological and Biochemical Studies of Auxin-like Herbicides' has been prepared during this time and should be ready for publication soon.

SUPPORTED BY U.S. Dept. of Agriculture

4.0528, THE FATE AND EFFECT OF HERBICIDES IN VEGETABLE CROPS

L.L. DANIELSON, Inst. for the Ap. of Nucl. En., *Belgrade, Zemun, Yugoslavia* (0710-03-11)

OBJECTIVE: Determine the effects of rate and time of application of herbicides on entrance, translocation, degradation balance, and loci of accumulation of herbicides and their degradation products in crop plants.

APPROACH: Research will be conducted in the phytotron, greenhouse, and field. The following herbicides and crops will be studied: linuron and prometryne on carrots and potatoes; CIPC and DNBP on onions; CIPC and prometryne on cabbage; amiben and prometryne on tomato and paprika; and DNBP and MCPB on peas. Field experiments will be conducted to determine effects on growth, yield and quality of product. Experiments will be conducted in the phytotron and greenhouse to identify and confirm specific metabolic cause and effect relationships in the use of herbicides on these crops.

PROGRESS: Studies were continued to determine the effects of a number of herbicides on seven vegetable crops grown in two locations. Significant effects on composition of the crops were associated with the herbicide treatments. For example, low concentrations of CDAA and chlorpropham significantly increased reducing sugar content and lowered total nitrogen content of cabbage. Linuron increased crude cellulose and mineral composition of potatoes. Vitamin C content in tomatoes was increased by chloramben treatments. Herbicidal efficiency was reduced in locations where rainfall was sparse. Continued measurements in successive years confirmed the persistence in soils of chloramben for 120 days, chlorpropham for 110 days, and CDAA for 70 days. Analyses for herbicide residues in treated crops showed no residues of chloramben in tomatoes or paprika, 0.03 ppm of CDAA and 0.09 ppm of chlorpropham in peas, 0.05 ppm of CDAA in onions, and 0.01 ppm of linuron and prometryne in carrots. The field experiments are being repeated in the various locations to confirm the data in successive seasons of variable climate.

SUPPORTED BY U.S. Dept. of Agriculture

D. ADVERSE EFFECTS ON ANIMALS AND MAN

Includes Toxicity, Reduction in Reproduction Rates, Survival of Nontarget Wildlife, and Food Chain Cycling.

4.0529, CHEMICAL CONTROL OF WEEDS IN PONDS

J.M. LAWRENCE, Auburn University, Agricultural Experiment Sta., *Auburn, Alabama* 36830 (ALA00427)

OBJECTIVE: Evaluate the activity of commercial and experimental herbicides and algacides on common pond weeds of this area. Determine the toxicological effects of the more promising aquatic herbicides and algacides to fish and fish-food organisms under controlled laboratory and field conditions. Investigate effects of more active aquatic herbicides and algacides on production of plankton, fish-food organisms, and fish in treated pools and ponds.

APPROACH: Twenty-five to 50 potential aquatic herbicides will be available for controlled laboratory evaluations each year. The more active of these herbicides will be evaluated in the laboratory for toxicity to fish. Controlled field evaluations of the most promising herbicides on 14 species of aquatic weeds and 2 species of fish will be set up each year.

PROGRESS: Treatments of diquat plus paraquat (.25 lb cation per acre of each) applied to Eurasian water milfoil (Myriophyllum spicatum) is spring provided control throughout summer, but no carry over of control was noted the following spring. Treatments of 2,4-DBEE granules (20 lbs per acre) applied to milfoil at same time eliminated infestation for 2 full summers, but treatments of 2,4-DBEE liquid (20 lbs a e per acre) provided control of milfoil for less than 6 weeks. Biological control of above-water growths of alligatorweed (Alternanthera philoxoides) with fleabeetle (Agasicles n.s.) resulted in suppression of regrowth for 8 to 10 weeks, and very limited regrowth for remainder of growing season. Chemical control with chlorophenoxy compounds resulted in complete kill of alligatorweed top-growth, but regrowth occurred within 4 weeks and three treatments were required per season to maintain satisfactory control.

SUPPORTED BY U.S. Dept. of Agriculture

4.0530, PESTICIDE-WILDLIFE RELATIONSHIPS

S.C. MCINTYRE, Auburn University, Agricultural Experiment Sta., *Auburn, Alabama* 36830 (ALA-13-0012)

OBJECTIVE: Collect basic information concerning insecticide residues in white-tailed deer, cottontail and swamp rabbits, and bobwhite quail associated with soybean production in Alabama. Determine the magnitude of contamination in these three game species and to relate this with FDA tolerances for these chemicals in commercial meat and poultry products.

APPROACH: Insecticide residue analyses are being conducted on tissues of specimens taken from insecticide sprayed soybean fields in Alabama.

PROGRESS: All field collections are complete. Tissue samples were taken from 22 white-tailed deer in or adjacent to insecticide treated soybean fields. Twenty-two deer were collected from areas not frequently treated with insecticides and used as control animals. Thirty-two rabbits and 20 bobwhite quail were collected from insecticide treated soybean fields and an appropriate number of control specimens of each were also taken. Most of the laboratory analysis is complete. Results indicate significant DDT residues in the rabbits and bobwhite quail from some areas. In general residues in white-tailed deer were low.

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4. PESTICIDES

SUPPORTED BY Alabama State Government

4.0531, EFFECT OF ENDRIN ON EGG-SPERM FORMATION AND EMBRYONIC DEVELOPMENT

R.L. ARGYLE, U.S. Dept. of the Interior, Bur. of Sport Fish. & Wildlife, *Marion, Alabama* 36756

Objectives: It has been well documented that certain chlorinated hydrocarbons have some effect on the reproductive potential of some bird populations. These effects have been manifest in reduced egg shell strength, high hatch mortality, and reduced clutch size to name only a few. It is speculated that chlorinated hydrocarbons may have a similar effect on fish reproduction and survival, especially in agricultural areas where pesticides are used intensively. Thus, it appears desirable to determine whether or not pesticides have an effect on eggs and sperm, and the development of the fertilized egg.

Procedure: For approximately a year prior to spawning, sexually mature channel catfish and goldfish will be fed pelletted feeds that contain 0, 1, 3 and 5 ppm endrin. Fish, water, soil and vegetation samples will be collected and analyzed periodically for endrin content. At time of spawning, fish will be paired with fish of opposite sex that have been similarly treated and other fish that have not been fed endrin. Effect will be based on hatching success and survival of fry.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0532, EFFECT OF ENDRIN ON FISH AND THEIR ENVIRONMENT UNDER CONTROLLED CONDITIONS

R.L. ARGYLE, U.S. Dept. of the Interior, Bur. of Sport Fish. & Wildlife, *Marion, Alabama* 36756

Objectives: In most studies conducted in open ponds, streams and other natural or simulated natural facilities, variations in light, water exchange, soil types and other factors between remote and even adjacently located test areas make it difficult for the investigator to measure the true effect of the test material. Many times, differences in the type and amount of flora and fauna in the control facilities exceed these differences that might exist between those areas that received pesticides and those that did not. In order to secure information on the true effect of pesticides on the environment, tests will be conducted in aquariums and troughs inside buildings. Thus, it is hoped that differences in soil, light, water and other factors that affect the environment can be minimized.

Procedure: Aquarium and trough bottoms will be layered with homogenous soil mixtures, sprigged with aquatic plants and filled with water. Fish and aquatic insects will be introduced. Metabolism of the pesticide (endrin) will be followed by using 14C-tagged endrin.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0533, PESTICIDES IN MAMMALIAN CELL SYSTEMS

R.A. CHUNG, Tuskegee Institute, George W. Carver Res. Found., *Tuskegee Institute, Alabama* 36088

Research will be continued to study the effect of pesticides in mammalian cell systems. Previous work has indicated that dieldrin and DDT suppressed cell count and the incorporation of labeled leucine into protein but increased that of labeled uridine into RNA. These effects were greater with time. Consequently, it is proposed to extend these studies to investigate: a) the changes in RNA and protein synthesis in different cellular organelles and in the time-course of RNA and protein synthesis in a few selected mammalian cells, b) the dynamics of the three RNA components (28S, 18S and 4S) and c) the aminoacyl acceptor activities in these cells.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0534, PESTICIDES RESEARCH

T.R. MERRELL, U.S. Dept. of the Interior, Bureau of Commercial Fisheries, *Auke Bay, Alaska* 99821

Our pesticide studies include two separate programs: One, the macro-invertebrate fauna of streams in Southeast Alaska are being studied to determine the ecological relationships between organisms and the seasonal abundance of dominant forms. The results will be used to predict effects of pesticides on stream fauna in the watersheds of similar streams in Southeast Alaska. The role of the invertebrate fauna in the diet of resident fishes is also being investigated.

Two, DDT residues in freshwater fish tissue is routinely monitored. Analyses of specimens collected from major river systems in the state show wide-spread contamination by DDT in many areas of Alaska. Fishes collected from the streams near population centers on military installations contain higher concentrations of DDT, DDD, and DDE than fishes from other parts of the state.

SUPPORTED BY U.S. Dept. of Interior - Bu. Comm. Fish

4.0535, HONEY BEE BEHAVIOR AND UTILIZATION

L.N. STANDIFER, U.S. Dept. of Agriculture, Entomology Research Division, *Tucson, Arizona* 85719 (00ENTC1003030100)

OBJECTIVE: Conduct research on honey bee behavior, develop methods for maximum utilization of bees in crop pollination and develop methods for minimizing the effects of pesticides and other farm practices on honey bees.

APPROACH: Determine the techniques for optimum utilization of honey bees on new and old crops, study plant factors that affect bee visitation, study the intermediary metabolism and nutritional requirements of larval and adult honey bees leading to development of synthetic diets. Research on physical, hormonal, and pheromonal regulation of growth and behavior of bees. Study sounds and vibrations transmitted by bees as an index to their condition. Study physiological, physical and social factors as behavior determinants. Develop methods and techniques for minimizing pesticide damage to bees. Study reproductive biology, function of cells and tissues and non pathogenic microflora of honey bees.

PROGRESS: Adult worker bees were found capable of producing precipitating and agglutinating antibodies, but not complement-fixing antibodies, in response to antigenic stimulation. Colonies with adequate protein reserves and fed sugar syrup and Beevert produced more brood than the control colonies that received only protein diet. A transeliminase that cleaves pectic substances at the alpha-1, 4- glycosidic bond between uronic acid units in polymers was found in the thorax of worker honey bees. Several species and varieties of citrus were studied, and Citrus depressa was found to be the most attractive to honey bees. Orlando tangelo trees caged with bees and Fairchild tangerine trees produced more than four times as much fruit as Orlando tangelo trees caged without bees. Substrate vibrations not only greatly reduced the number of bees leaving an observation hive, but they stopped the bees almost completely from reaching the feeding station. Combs made of ABS plastic were preferred by package bees over all other plastics tested. Components of an aroma carried by foraging bees may direct recruits to a location or food source different from that which the dancing forager has visited. Spermatozoa retained their fertilizing capacity 247 days when stored with streptomycin at 13 C in glass tubes. Seven herbicides were moderately to highly toxic and eight other herbicides were relatively nontoxic to newly emerged bees when fed at 10, 100, and 1000 ppm in sugar syrup.

SUPPORTED BY U.S. Dept. of Agriculture

4.0536, ARIZONA COMMUNITY STUDIES PESTICIDE PROJECT

C.C. ROAN, Univ. of Arizona, Agricultural Experiment Sta., *Tucson, Arizona* 85721 (ARZT-5010-4161-014)

OBJECTIVE: Effects of pesticides on health of man.

APPROACH: Intensive medical and biochemical investigation, from an epidemiological approach, of occupationally exposed individuals in contrast to matched general population individuals.

PROGRESS: Preliminary data indicate a drastic reduction in sale and application of DDT. Total of all pesticide sales (preliminary) do not show a marked change. Man has the highest pesticide concentrations in adipose tissue of all mammals sampled in Arizona. A detailed investigation of urinary tract irritation in pesticide workers suggests some seasonal irritation that is not of a

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persistent nature. There appears to be a moderate hyper-globulinemia in our exposed subjects, compared to our own controls. None of the values are remarkable beyond normal limits. Blood cholesterol was found to be significantly higher in the occupational groups than in controls, though the difference is not extraordinary and is probably due, in part, to age differences among the subject groups. Studies of the effects on man of DDT have been initiated using human volunteers on daily oral doses of DDT and related chemicals. Evaluation of occupational hazards indicates that protective measures and equipment that are recommended are probably inadequate.

SUPPORTED BY Arizona State Government

4.0537, CHLORINATED HYDROCARBON IN THE LACTATING BOVINE AND EFFECT ON LIPID METABOLISM

J.W. STULL, Univ. of Arizona, Agricultural Experiment Sta., *Tucson, Arizona* 85721 (ARZT-2014-4160-008)

OBJECTIVE: Develop a method or methods by which it will be possible to quickly and economically purge a cow of enough of her pesticide residue to allow the production of legal milk without impairing her ability to produce milk.

APPROACH: A series of experiments will be carried out in which cows will first be given dosages of DDT which will cause them to produce milk fat containing 15-20 ppm of pesticide residue. Iodinated casein and two levels of energy under various conditions will then be fed so as to determine their effect on pesticide removal from body tissue during periods of general fat mobilization.

PROGRESS: Twelve Holstein heifers were divided into three groups and placed on experiment at an age just before puberty. All animals were fed at a constant pesticide intake through their first lactation. The pesticide was fed as aged residue in field contamination alfalfa hay. The pesticide output in their milk was monitored at weekly intervals for the first month and at monthly intervals for the rest of the lactation. Total DDT and its metabolites secreted in the milk fat was 0.89, 1.34 and 2.45 parts per million (ppm) for the groups receiving 0.25, 0.50 and 1.00 parts (ppm) DDT in the feed, respectively. Groups of unbred heifers were placed on one of three levels of DDT intake; namely 0.25, 0.5, or 1.0 (ppm). After normal gestation and parturition, newborn calves were sacrificed from dams in each group. Extractable lipid material from blood, brain, placenta, gonads, muscle, kidney, liver and renal fat was analyzed for DDT and its metabolites. Renal fat had the highest concentration of pesticide. (1.65 ppm at 1.0 ppm dietary intake). The lipid extracted from brain and liver tissue had the next highest and virtually identical values (0.072 and 0.073 ppm respectively) at the highest level of dietary intake. At the same level of intake, pesticide concentration in the blood lipid was the lowest (0.001 ppm) while that in muscle, placenta, gonad and kidney was 0.012, 0.015, 0.016 and 0.029 ppm, respectively.

SUPPORTED BY U.S. Dept. of Agriculture

4.0538, PESTICIDE DEPOSITION IN POULTRY

C.W. WEBER, Univ. of Arizona, Agricultural Experiment Sta., *Tucson, Arizona* 85721 (ARZT-9005-206-597)

OBJECTIVE: Determine the amount of DDT and its metabolite DDE which occur in locally-produced eggs and poultry, evaluate the relationship between dietary content and deposition of DDT in eggs and tissue.

APPROACH: Preliminary studies will involve the determination of DDT and its metabolic products in eggs obtained from commercial channels. In subsequent studies, analysis of DDT in experimental poultry diets, and in eggs and poultry tissues, will be carried out. Mature hens will be fed various levels of DDT for 1 to 6 months. A portion of the hens in each group will be removed from the diets containing DDT at monthly intervals, and sacrificed to determine the extent of DDT retention after 1, 2 and 3 months.

PROGRESS: Mature Japanese quail were fed 0, 100, 200 and 400 p.p.m. DDT in the diet for 60 days and its effect on egg production, mortality, fertility, hatchability and pesticide content of yolks determined. The levels of DDT fed had no effect on average egg production and there were no differences in mortality, hatchability or fertility between the 0, 100 and 200 p.p.m. DDT groups. The pesticide content of yolks increased in proportion to the amount of dietary pesticide consumed. Ingestion of 400 ppm DDT in the feed for 30 days resulted in 50% mortality in the adult quail. A marked decline in fertility and, to a lesser degree, hatchability, was noted after 30 days of feeding the 400 ppm diet. The day-old chicks from birds fed 400 ppm DDT for 30 days exhibited ataxia and spasms. Yolk samples of these eggs contained 78 ppm DDE and 141 ppm DDT. After a period of 60 days on 400 ppm DDT, the yolks were found to contain 184 ppm DDE and 358 ppm DDT.

SUPPORTED BY U.S. Dept. of Agriculture

4.0539, EFFECT OF MOSQUITO CONTROL CHEMICALS ON AQUATIC FAUNA

J.L. LANCASTER, Univ. of Arkansas, Water Resources Research Ctr., *Fayetteville, Arkansas* 72701

It is proposed to make applications of malathion, Abate, Flit MLO and Baytex to all mosquito breeding water each in a square mile section. It is also planned to put ethyl parathion in rice irrigation water in all rice fields wherever they occur in these sections. It is anticipated that two aerial applications of malathion over the entire 4 square miles may be needed each year. Pre and post-treatment samples from each area will be collected, concentrated, and later analyzed in the laboratory to determine what changes, if any, occur in the fauna that can be directly attributed to the chemicals used. Sampling will be continuous on a selected time schedule and comparisons made to similar samples from an adjacent untreated area. The research site (Lonoke, Arkansas) will be divided into four sections to provide for comparison between the four insecticides.

SUPPORTED BY U.S. Dept. of Interior - O. Wtr. Res. Rch.

4.0540, DETERMINATION OF THE TOXICITY OF TERRAMYCIN TO CATFISHES (REVISED)

F.P. MEYER, U.S. Dept. of the Interior, Fish Farming Exptl. Sta., *Stuttgart, Arkansas* 72160

Blue and channel catfishes will be force-fed known levels of Terramycin at rates ranging from the standard therapeutic dosage to levels forty times that. Toxicity symptoms will be recorded, mortality rates, and related data will be recorded.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0541, REMOVAL OF COMPETING PAMPAS GRASS (CORTADERIA SELLOANA) FROM REDWOOD REFORESTATION AREAS

D. THORNBURGH, Humboldt State College, School Forestry, *Arcata, California* 95521 (CALZ00010)

OBJECTIVE: Investigate the use of various herbicides for controlling pampas grass in recently harvested redwood forest areas.

APPROACH: Various herbicides (2,4-D, 2,4,5-T and commercial compounds) at different concentrations and mixtures will be used to determine the phytotoxic levels on redwood. These critical concentrations will then be tested for effectiveness against pampas grass. The applications would be sprayed in the field. In addition, seasonal and selective placement applications will be tested on pampas grass and redwood.

PROGRESS: This project began in April, 1968 and is still under progress. The critical concentrations for killing pampas grass have been determined for paraquat, diquat, 2,4-D and 2,4,5-T. Unit area application rates have also been measured for the above four chemicals along with various mixtures of the chemicals with different carriers. The conifers are either killed or set back by the same concentrations that affect the competing pampas grass. The pampas grass attracts large browsing mammals, who also browse the coniferous regeneration. The recommended solution to the problem of competing pampas grass is to spray the grass and plant the area with sitka spruce. The spruce will not be browsed and will be able to outcompete the pampas grass that comes back in. (2 senior students).

4. PESTICIDES

SUPPORTED BY U.S. Dept. of Agriculture

4.0542, EFFECTS OF PESTICIDES ON AQUATIC ANIMALS IN THE ESTUARINE AND MARINE ENVIRONMENTS

R.D. EARNEST, U.S. Dept. of the Interior, Bur. of Sport Fish. & Wildlife, *Belvedere, California* 94920

This study is a continuing program for deriving toxicities TLm of various pesticides against estuarine invertebrates in both flowing- water and static conditions. TLm estimates may be based on exposures as brief as 24-96 hr in static tests or as long as 25-30 days in continuous-flow systems. Biological responses other than mortality will be evaluated when appropriate.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0543, EFFECTS OF PESTICIDES ON AQUATIC ANIMALS IN THE ESTUARINE AND MARINE ENVIRONMENTS

R.D. EARNEST, U.S. Dept. of the Interior, Bur. of Sport Fish. & Wildlife, *Belvedere, California* 94920

We will determine the median tolerance limits (TLm) of the Korean shrimp to various pesticides found in San Fransisco Bay. The animal will be exposed for brief intervals under both static and intermittent- flow conditions for comparison.

Appropriate concentrations under continuous-flow conditions allowing 30-day exposures will be used to evaluate the effects on molting.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0544, EFFECTS OF PESTICIDES ON AQUATIC ANIMALS IN THE ESTUARINE AND MARINE ENVIRONMENTS

R.D. EARNEST, U.S. Dept. of the Interior, Bur. of Sport Fish. & Wildlife, *Belvedere, California* 94920

This study is a continuing effort in deriving median tolerance limits (TLm) of estuarine fishes to a variety of pesticides and combinations of pesticides. Static testing conditions will yield TLms for 24-96 hr intervals and continuous-flow conditions will be used for exposures as long as 30 days. The tests will include standard and varied conditions of temperature and water quality.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0545, EFFECTS OF PESTICIDES ON AQUATIC ANIMALS IN THE ESTUARINE AND MARINE ENVIRONMENTS

R.D. EARNEST, U.S. Dept. of the Interior, Bur. of Sport Fish. & Wildlife, *Belvedere, California* 94920

Immature chinook salmon will be exposed to methoxychlor in individual doses of 0.2 mg/kg body wt. per day by diet, 3 micrograms/l by bath or 0.06 mg/kg body wt per day and l microgram/l by diet and bath combined. Estimates of total body fat and methoxychlor residue in the brain, mesenteric fat, fillet, liver, and whole blood will be evaluated serially for 6 months. These estimations will be continued two additional months to evaluate the biological half-life of the toxicant.

Other biological parameters to be characterized serially during and after exposure include hematology, growth, histopathology, and liver lipids and glycogen. Tests, after termination of exposure, include saltwater challenge, thermal shock, recovery time from barbiturate anesthesia, and 72-hr radioiodine uptake by the thyroid.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0546, INTEGRATED CONTROL OF PEACH INSECT PESTS

L.E. CALTAGIRONE, Univ. of California, Agricultural Experiment Sta., *Berkeley, California* 94720 (CA-B0-BIC-2227)

OBJECTIVE: Determine natural enemies of Oriental fruit moth and their effect on the pest population. Import and colonize in California exotic natural enemies of the pest. Integrate both biological and chemical control procedures.

APPROACH: Periodic sampling of peach orchards in the Central Valley of California will be done all year round in order to find out the density and age distribution of the pest, the natural enemies present and their importance, the levels of infestation and their significance measured as percentage of fruit infested. Foreign exploration for natural enemies of the pest will be made. The species found, as well as some of those known to occur in other states, but not in California, will be cultured and colonized. The effect the pesticides have on natural enemies, both native and imported, will be measured.

PROGRESS: In an experimental peach orchard in the Sacramento Valley the 1969 pest control program consisted of a dormant spray with oil plus diazinone, and 2 applications of azinphosmethyl during the growing season against oriental fruit moth and twig borer. Again this season the population of the predaceous mite Metaseiulus occidentalis was high enough to control the two-spotted mite and the European red mite. This was the 5th consecutive season without applying acaricides in this orchard. Large numbers of Chrysopa carnea and C. nigricornis occur in this orchard since the application of insecticides was reduced. Their role in the population dynamics of the insects and mites occurring in this orchard has not been investigated.

SUPPORTED BY California State Government - Sacramento

4.0547, ASPECTS OF THE BIOCHEMICAL TOXICOLOGY OF INSECTICIDE CHEMICALS

J.E. CASIDA, Univ. of California, School of Agriculture, *Berkeley, California* 94720

No summary has been provided to the Science Information Exchange.

SUPPORTED BY John S. Guggenheim Memorial Foundation

4.0548, METABOLISM AND SELECTIVITY OF ORGANOPHOSPHATES

J.E. CASIDA, Univ. of California, School of Agriculture, *Berkeley, California* 94720

Needed background information is being developed on the metabolism, fate, mode of action, and structure-activity relationships of certain esterase- inhibiting insecticide chemicals in order to evaluate conditions for their safe and efficient use. The specific studies underway or planned concern 1) the photodegradation chemistry and the metabolic fate and mode of action of new carbamate-type insecticide chemicals, having novel structure or mode of action, in insects, in mammals, and in plants, 2) the effect of possible inhibitors and inducers on metabolism of carbamate insecticide chemicals by living mice and by the liver microsomal mixed-function oxidase system, 3) the biochemical basis for the induction of teratogenesis by certain insecticide chemicals in chicken embryos, 4) the biochemical genetics of resistance mechanisms in house flies, 5) the comparative biochemistry of insect and mammalian microsomal mixed-function oxidases, 6) the source of oxygen in the formation of oxon derivatives of phosphorothionates, 7) the mechanism by which synergists inhibit the metabolism of insecticide chemicals and the involvement of mixed-function oxidases in it, 8) the mode of action and role of photo-sensitizers on the photoalteration of insecticide chemicals (if any), and 9) the metabolism, photodecomposition, and mode of action of new insecticide chemicals (if any). The experimental approach involves subjection of the chemical to an organismal, biochemical or photochemical system, separation and resolution of any product formed, determination and characterization of these products, and assay of their biological activity, utilizing appropriate combinations of chromatographic, radiochemical, and bioassay experiments.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0549, INFLUENCE OF CHEMICAL PESTICIDES ON FOREST COMMUNITIES

D.L. DAHLSTEN, Univ. of California, Agricultural Experiment Sta., *Berkeley, California* 94720 (CA-B0-BIC-2523)

OBJECTIVE: Ascertain the effect of pesticides, particularly the subelethal effects, on the various developmental stages of birds (i.e., adult, eggs, nestling, fledgling and juvenal); discover the links in the movement of pesticides through food chains in selected forest environments; investigate the impact of pesticides on non-target arthropods, specifically the induced imbalance in parasite-host and predator-prey relationships; determine changes in floral diversity, if any, and the causes of change.

APPROACH: Determine effects of chemical pesticides on stability of forest communities. Important components of the study are determination of residue levels in birds, movement of toxins through food chains and impact on parasitoid-host relationships. Ten permanent study areas permit research on an area basis rather than species basis. Some areas have history of chemical treatment. Nest boxes for chickadees are used to compare birds populations. Aphid-parasitoid fluctuations are being studied. Light traps are used in treated and untreated areas to prepare an index of stability based on number of species and number of individuals in each species of nocturnal Lepidoptera. One untreated area will be treated in three years in an attempt to induce instability.

PROGRESS: One 360 acre area was sprayed with DDT at the standard rate of 3/4 pound per acre during July. Each of the four research projects in the study have sample plots within the sprayed area. Nesting success in the five fifty-box plots was the highest it has been since the beginning of the study (50% acceptance). There was only one occurrence of renesting which was considerably less than the previous two years. The mean number of eggs per nest was 6.6; of nestlings 5.9, and of fledglings, 5.7. Total mortality was 14.5 percent. The reason for this productive year is unknown but it appears that there is a correlation between spring weather and productivity. The 1968-69 winter was very severe but this did not seem to affect the mountain chickadee. Close to 700 birds were banded in 1969. The cement nesting boxes were compared with the wooden boxes for the second year. Cement boxes are vastly superior and use of wooden boxes will be discontinued in the future. Stomach samples were taken from six areas and compared.

SUPPORTED BY California State Government - Sacramento

4.0550, INFLUENCE OF CHEMICAL PESTICIDES ON FOREST COMMUNITIES

D.L. DAHLSTEN, Univ. of California, School of Agriculture, *Berkeley, California* 94720

After two years of study, one of five permanent study plots was treated with DDT at the rate of 3/4 pound in one gallon of water per acre on July 3. A total of 320 acres was treated. The spray was not intended for any insect in particular but was timed to simulate a typical forest defoliator treatment. Studies of soil microarthropods and of forest pond organisms were initiated just prior to treatment. Studies of insectivorous hole-nesting birds and nocturnal macrolepidoptera were continued for the third year.

Soil samples were taken for residue analyses as well as for microarthropod abundance. Aquatic samples were also taken from ephemeral ponds. The pond in the treated area was decimated. The first organisms to return were notonectids and corixids. These organisms flew into the sprayed pond from other areas and may be important in re- establishing diversity. However, they may also be important in contaminating other ponds.

A total of 311 species of nocturnal lepidoptera have now been trapped in three years. The Geometridae were the most affected by the spraying.

Nesting box acceptance by mountain chickadees was the highest it has ever been. The effects of DDT, if any, should begin to appear in the 1970 breeding season.

SUPPORTED BY U.S. Environ. Protect. Agency - O.O.P.P.

4.0551, CHLORINATED HYDROCARBONS - PATTERNS AND EFFECTS UPON THE REPRODUCTIVE CAPACITY OF ANTARCTIC PELAGIC SEA BIRDS

H.S. OLCOTT, Univ. of California, School of Agriculture, *Berkeley, California* 94720

Studies approved under GA-14202 for a first season in the Antarctic Peninsula included plans for studies on pollution ecology on Kerguelen Island. Because cruise rescheduling delayed the latter plans until early 1971, support is now required for participation in 'Eltanin' Cruise 47 and the cooperative research on pollution ecology on Kerguelen Island. This activity is coordinated by Dr. Risebrough, U/California, Berkeley, and Dr. Hubert Ceccaldi of the Station Marine d'Endoume et Centre d'Oceanographie, Marseilles, France, as American-French cooperative research. In addition, field work is planned at Cape Hallett for comparative data in analyzing the Palmer Station materials collected in 1970. Since polychlorinated-biphenyl (PCB) and DDT are now most abundant in the marine ecosystem, the Antarctic and Subantarctic studies will make an important contribution on global fallout patterns by studying seabirds with restricted ranges in isolated areas (Kerguelen) and by sampling the wide ranging Wilson's petrel (Palmer and Hallett Station).

Dr. Robert Risebrough, Research Associate and an assistant will work at Hallett Station October-December 1970, and proceed from New Zealand to Australia to join 'Eltanin' Cruise 47 for 30 days' work on Kerguelen Island. Travel in New Zealand and Australia to collect local samples and to Marseilles, France, for analyses of Kerguelen data is approved in connection with this research. USARP transportation will be provided from California to New Zealand, and New Zealand to Freemantle, Australia.

SUPPORTED BY U.S. National Science Foundation

4.0552, BIOLOGICAL CONTROL OF COTTON INSECTS

R. VANDENBOSCH, Univ. of California, Agricultural Experiment Sta., *Berkeley, California* 94720 (CA-B0-BIC-2132)

OBJECTIVE: A faunistic survey of the parasitic and predaceous arthropods bionomical studies of beneficial species; evaluation of the effectiveness of natural enemies; importation of beneficial species from outside California; determination of effects of pest control chemicals and other agricultural practices on beneficial species; and integration of biological and chemical control.

APPROACH: Collection, preservation, and identification of predatory species from cotton growing areas; distribution and phenology of the key beneficial species; life history studies of the important entomophagous species; laboratory feeding and host selection tests; field observation of hosts attacked, rearings to determine degree of parasitization and exclusion experiments to measure natural enemy efficacy, determine insecticide effects on beneficial species; search for, transhipment culture, colonization, and evaluation of exotic beneficial forms; and experimental evaluation of mass releases of such beneficials as Trichogramma, Chrysopa, etc.

PROGRESS: A caterpillar backlash to chemical insecticides was demonstrated in a Lygus control experiment near Corcoran, where beet armyworm infestations in two chemical treatment programs were respectively about 16 and 18 times as great as that in the untreated control. This is attributed to adverse effect of the chemicals on predators. An analysis of biotic mortality agents of the cabbage looper revealed that this species suffered heavily from parasitization by the wasp Copidosoma truncatellum and a nuclear polyhedrosis virus. Predator impact was not evaluated. In chemically untreated cotton plots in Kern County the natural enemies effected complete regulation of the cabbage looper population by Sept. 1. A whole plant insect sampling device was developed in collaboration with colleagues and tested in the field.

SUPPORTED BY California State Government - Sacramento

4.0553, CONTROL METHODS FOR CALIFORNIA GROUND SQUIRRELS

V.B. RICHENS, U.S. Dept. of the Interior, Denver Wildlife Res. Ctr., *Davis, California* 95616

Objectives: To evaluate candidate toxicants and bait materials for controlling damage by California ground squirrels in agricultural areas on the West Coast.

Procedures: Promising materials, including oral and contact poisons, gases or inhalants, and systemic compounds, will be tested on California ground squirrels. Acute oral toxicity is determined by gavage, bait acceptance by offerings to squirrels in individual cages in the laboratory, and control success by field testing. Hazards to other animals are determined by gavage, baiting, and feeding carcasses of poisoned rodents.

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SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0554, AERIAL DISPERSAL METHODS FOR CONCENTRATED INSECTICIDES

N.B. AKESSON, Univ. of California, Agricultural Experiment Sta., *Davis, California* 95616 (00ENTH01090508CO)

OBJECTIVE: Develop and evaluate methods of aerial application of various insecticide formulations as concentrated or undiluted sprays for control of mosquitoes.

APPROACH: Design and/or utilize effective aerial spray systems to apply low volumes of concentrated insecticide materials. Evaluate promising insecticides against mosquito larvae and adults breeding in irrigated pastures by aerial application low volume techniques.

PROGRESS: Low-volume applications have demonstrated good mosquito control in rice fields and pastures treated by helicopter in the Colusa area, including the Colusa Wildlife Refuge. Dursban was applied at 0.05, 0.025, and 0.0125 lb/acre and fenthion at 0.1 lb/acre. The swath width was 250 feet and a volume of 6.1 fluid oz/acre was applied. So far, during studies of possible effects on bees and wildlife, no damage has been noted. In cooperation with the U.S. Navy and the California Bureau of Vector Control, studies were made in Kern County to determine whether low-volume applications could be successfully made at altitudes of 1,000 and 2,000 feet. Both larvae and adult mosquitoes were killed from altitudes up to 2,000 feet over swaths extending 1/2 mile wide at dosage rates less than 8 fluid ounces per acre.

SUPPORTED BY U.S. Dept. of Agriculture

4.0555, BIOLOGICAL METHODS OF CONTROL FOR INTERNAL PARASITES OF LIVESTOCK

N.F. BAKER, Univ. of California, Agricultural Experiment Sta., *Davis, California* 95616 (CA-V0-VMB-2535-RR)

OBJECTIVE: Study the genetics of susceptibility and of virulence in internal parasites.

APPROACH: Isolate organophosphate resistant and susceptible strains of Ostertagia circumcincta. Study the action of organophosphates on these strains in vitro and in vivo. The in vivo studies to be conducted in both plasma A esterase positive and negative sheep. Pharmacology of organophosphates in the latter genetic types of sheep to be evaluated.

PROGRESS: It was established that anthelminthic activity of Haloxon is not influenced by the presence or absence of the plasma A- esterase which protects sheep of this genetic phenotype from acute and chronic toxicity of Haloxon. It was further demonstrated that susceptability to helminth infection did not segregate with the EsA genotype.

SUPPORTED BY U.S. Dept. of Agriculture

4.0556, PESTICIDE RESIDUES IN PLANTS, ANIMALS AND SOILS

D.G. CROSBY, Univ. of California, Agricultural Experiment Sta., *Davis, California* 95616 (CA-D0-ETX-2183-RR)

OBJECTIVE: Survey the decomposition of commercial pesticides by light and air; identify chemically breakdown products, synthesize compounds; determine their acute toxicity in animals, devise and test analytical methods for estimation of these compounds on treated crops.

APPROACH: Survey of effects of sunlight, air, and moisture on selected members of major classes of commercial pesticide normally exposed in practice; determination of structure by physical and chemical means; toxicological study of decomposition products in rats and/or mice; development of analytical methods.

PROGRESS: DDT underwent photolysis in ultraviolet light, although the process was slow in the wavelength region of sunlight. Both in solution and in the solid state, photooxidation produced the dichlorobenzophenone and p-chlorobenzoic acid derivatives expected from the decomposition of an intermediate hydroperoxide. Propanil, 4- chlorophenoxyacetic acid (4-CPA), and monuron readily underwent photooxidation and photoreduction also; in the instance of monuron, photooxidation products were identical with those formed by reaction of the herbicide with peroxytrifluoroacetic acid and by mammalian and plant metabolism.

SUPPORTED BY U.S. Dept. of Agriculture

4.0557, BIOLOGICAL EFFECTS OF ENVIRONMENTAL FACTORS IN BIRDS AND ANIMALS

L.Z. MCFARLAND, Univ. of California, Agricultural Experiment Sta., *Davis, California* 95616 (CA-V0-ANA-2151)

OBJECTIVE: Evaluate acute and chronic toxicity of chlorinated hydrocarbon and organophosphate pesticides in birds.

APPROACH: Study chronic effects of pesticides. Newly hatched Japanese quail will receive pesticide in starter mash during a six week test period. At weekly intervals, treated and untreated birds will be removed for study. Morphological changes including weights of brain, liver, kidneys, gonads, adrenals, thyroids and pituitary will be evaluated. Biochemical changes will be studied including hexokinase, glutamic dehydrogenase, aldolase and other enzymes. Physiological measurements (EEG, heart rate, respiratory rate, etc.) will be made at 2, 4 and 6 weeks of age. Acute effects of pesticides will be studied in waterfowl. A dose will be sought that will cause death in 60 minutes when given intravenously in vegetable oil. Physiological measurements will be evaluated.

PROGRESS: The chronic residual effect from Kepone ingestion was examined in laying Japanese quail. Data were gathered on total egg weight, egg shell weight, egg shell thickness, body weight and death before, during, and after Kepone exposure. Kepone treatment caused a 20% thinning of the egg shell and a high incidence of soft-shelled eggs. Social 'stress' at 77 days post-treatment caused a significant thinning of egg shells and a 43% mortality, at 100 days a 95% mortality. The livers of quail treated with Kepone had lipid inclusions, an apparent disruption of the mitochondrial cristae, and in extreme cases myelinated figures replaced mitrochondria. There was no significant increase in agranular endoplasmic reticulum, in contrast to what is observed in mammals, but there was an accentuation of the bile canaliculi, and particles within these canals. The Kupffer cells were stimulated, and their cytoplasm contained increased number of lysosomes. Starvation decreased the weight of body, liver, heart, kidney, but not brain. There were altered enzyme activities in these organs. DDT in conjunction with starvation reduced gluconeogenesis in the liver by reducing PEP-carboxykinase and increasing glucokinase activities. Oviductal glucokinase, hexokinase, pyruvate kinase, hexose isomerase, and lactic dehydrogenase were reversibly inhibited by Kepone.

SUPPORTED BY California State Government - Sacramento

4.0558, CONTROLLED GROWTH AND METABOLISM OF AVIAN CELLS

B.W. WILSON, Univ. of California, Agricultural Experiment Sta., *Davis, California* 95616 (CA-D0-AVS-2221-H)

OBJECTIVE: Study factors which regulate growth and development of avian embryo cells and tissues, both in vivo and in vitro. To develop controlled, perfused systems for cultivation of embryonic cells and tissues.

APPROACH: Pesticides and other biologically active chemicals and genetically different strains of birds will be used to investigate regulation of avian cell and tissue growth and development.

PROGRESS: Denervation and tenotomy studies of biceps muscles from normal and dystrophic chicks showed that innervation is needed to repress embryo acetylcholinesterase forms in normal muscle and that such does not obtain in dystrophic muscle. Cell culture studies showed that the cholinesterases of skeletal muscle and heart in vitro corresponded to the isozymes of their tissues-of-origin and demonstrated that innervation per se is not necessary to maintain embryo acetylcholinesterases. Parathion, paraoxon, malathion and malaoxon were less toxic to the growth and less inhibitory to the respiration of highly differentiated muscle cell cultures than they were to relatively undifferentiated cells. Inhibitor studies on the cholinesterases of cultured cells are underway. The data lend insight into the regulation of acetylcholinesterases - the target enzymes for the action of many pesticides. In addition, the results demonstrate that nerves play a vital role in the loss of embryonic properties that accompany muscle maturation and strongly suggest that nerve-muscle interactions are abnormal in birds with inherited muscular dystrophy.

SUPPORTED BY U.S. Dept. of Agriculture

4.0559, PHYSIOLOGICAL CONSEQUENCES OF LONG-TERM EXPOSURE TO LOW LEVELS OF TOXICANTS

D.E. WOOLLEY, Univ. of California, Agricultural Experiment Sta., *Davis, California* 95616 (CA-D0-XXX-2288-H)

OBJECTIVE: A study of the physiological changes in animals resulting from exposure to low chronic levels of pesticidal toxicants.

APPROACH: Designed to develop understanding of the impact of asymptomatic burdens on normal physiological parameters, and of interaction of environmental stresses of these effects. Neurotoxicological effects of acute exposure to DDT and Dieldrin in rats.

PROGRESS: The effects of DDT were investigated in adult and developing rats. Adult female rats were exposed to 0, 25, 100, or 200 ppm DDT in the diet throughout pregnancy and lactation, and the offspring were maintained on the same diets after weaning until termination of the study at 84 days of age. Rats born to mothers on the 2 higher levels of dietary DDT showed a delay in the development of the nervous system, as indicated by a delay in development of the righting and startle reflexes. Puberty occurred slightly earlier in the 200 ppm DDT group. Maximal electroshock seizure (MES) responses were elicited at 10 and 70 days of age in the offspring rats. Administration of a subconvulsant dose of strychnine (250 microgram/kg) 30 minutes before the MES test caused the motor responses during the convulsion to be more intense or severe in rats on 0 ppm DDT. This effect of strychnine did not occur at all or was significantly less intense in rats on the levels of dietary DDT, showing that DDT was able to counteract this action of strychnine. Some of the results of this study suggested that the nervous system is relatively insensitive to the effects of chronic exposure to DDT. For example, 100 ppm dietary DDT did not alter the seizure pattern in the adult. However, with more sensitive endpoints even lower levels of DDT were shown to affect the nervous system. Thus, even 25 ppm dietary DDT (which is still considerably higher than levels actually found in food) counteracted some of the effects of strychnine. The results of other studies permitted the conclusions that a greater dose of DDT is required for toxic effects in the young rat than in the adult.

SUPPORTED BY U.S. Dept. of Agriculture

4.0560, METABOLISM OF CARBAMATE PESTICIDES

A. STROTHER, Loma Linda University, School of Medicine, *Loma Linda, California* 92354

The comparative study of the metabolism of certain -aryl substituted methylcarbamate pesticides by human and rat liver fractions will be completed. The completion is estimated to take approximately four months. The continuation program will cover three phases of carbamate metabolism. Phase one is a study of the metabolism of five carbon-14 labeled methylcarbamates by the human placental microsomes. This study should provide important information concerning the metabolic action of this tissue on the carbamates and the possible hazards they might present to the fetus. The possibility that the carbamates or metabolites may be bound to placental proteins will be determined. Their metabolic pathways in this tissue will be studied and differences between it and other organs, such as the liver, noted. Phase two will be concerned with the possibility that the carbamates may stimulate or inhibit certain enzyme systems which metabolize them or other drugs. This part of the study may indicate if after prolonged exposure the carbamates might become less toxic (LD sub 50 increased) or more toxic (LD sub 50 decreased) and which metabolic pathways may possibly be $ altered. Phase three will involve in vitro studies of the metabolism of Zectran (4-dimethylamino-3,5-xylyl methylcarbamate) by various organs of the dog to attempt to locate the site of the enzymatic conversion (if it is truly an enzymatic reaction) of the carbamate to 3,6-dimethylhydroquinone. Matacil (4-dimethylamino-m-tolyl methylcarbamate) a compound of similar structure will also be studied in efforts to determine if the pathway is truly metabolic or not.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0561, EFFECT OF PESTICIDES ON APICULTURE

E.L. ATKINS, Univ. of California, Agricultural Experiment Sta., *Riverside, California* 92502 (CA-R0-SSE-1499)

OBJECTIVE: Determine the effect of pesticides on the California multimillion dollar apiculture industry.

APPROACH: Laboratory dust tests will be continued on all new compounds yet untested on honey bees. Also laboratory tests will be continued on honey bee pesticide resistance studies.

PROGRESS: Laboratory tests to determine the toxicity of 72 pesticides to honeybees were completed: 1 compound was highly toxic; 2 compounds were moderately toxic; and 69 compounds were essentially non- toxic. Over 294 laboratory and field tests with American Foul Brood were conducted to develop fumigants to decontaminate infected hive equipment and combs. Ethylene oxide was tested at dosages of 450 mg/l at various time exposures to 24 hrs. and temperatures of 80F to 100F & 50-70% R.H. Laboratory tests were promising whereas field tests were negative. Compound 'A' was promising at 4.5 ml/l in lab tests but negative in a field test. Compound 'B' at 0.5-5 gm/cu ft. polymerized with heat showed promise as a sporicide in a field test. Eight large 16-acre field tests with pesticides applied to seed alfalfa were conducted. Carzol at 16 oz/A caused a 2-day reduction in forager bee visitation and killed a moderate number of bees for 1 day. Monitor at 16 oz/A caused a reduction in visitation for 4 days and killed a moderately heavy number of bees for 1 1/2 days. Monitor at 8 oz/A caused 3-day reduction in bee visitation and killed a moderate number of bees for 1 day. Toxaphene-DDT-Dylox at 4-2-1 lbs/A caused a 2-day visitation reduction and killed no bees. Lannate at 16 oz/A caused a 4- day visitation reduction and killed a moderately heavy number of bees for 1 1/2 days. Lannate at 8 oz/A caused a 2-day visitation reduction and killed a moderate number of bees for 1 1/2 days. Biothion-Thimet at 8-8 oz/A caused a 1-day visitation reduction and killed a moderate number of bees for 1 day.

SUPPORTED BY California State Government - Sacramento

4.0562, BIOLOGY AND CONTROL OF ORANGEWORMS ATTACKING CITRUS, WITH REFERENCE TO ORANGE TORTRIX

E.L. ATKINS, Univ. of California, Agricultural Experiment Sta., *Riverside, California* 92502 (CA-R0-SSE-1084)

OBJECTIVE: Provide a means of identification, biological and economical information, satisfactory and practical chemical control measures, and cultural methods.

APPROACH: Research in the project will provide new information concerning biological information; rearing techniques; taxonomic studies; practical chemical control measures for all of the current economic species and those anticipated in the future; integration of orangeworm chemical and biological control of other citrus pests; and, the completion of research in progress.

PROGRESS: Over 60 citrus plots of 1 acre were applied during the year to study 19 pesticides on orange tortrix, fruit tree leaf roller, citrus cutworm, omnivorous leaf roller, orange dog and citrus peel miner. Most of the pesticides were effective on at least 1 species of orangeworms. Approximately 75% of the citrus treated for orangeworms is treated during the bloom period and there is pressure to delete DDT and TDE from citrus control recommendations as soon as suitable substitutes can be developed. DDT and TDE have been extensively used during the bloom period since both are moderately toxic to honeybees at the dosages applied. Therefore, we are particularly interested in finding pesticides which are toxic to honeybees visiting the citrus blossoms. Dylox (Reg) and chlorphenamidine are both essentially non-toxic to bees. Dylox (Reg) sprays at 4 lbs. ai/A controlled orange tortrix, citrus cutworm and fruit tree leaf roller; at 1 lb. ai/A controlled omnivorous leaf roller. More tests are planned for 1970 to establish minimum effective dosages for the various orangeworms. Additional residue samples will be gathered to aid in registration of these 2 compounds to replace DDT and TDE.

4. PESTICIDES

SUPPORTED BY California State Government - Sacramento

4.0563, MOLECULAR MECHANISMS FOR ACTION OF GROWTH REGULATORS AND HERBICIDES

J. KUMAMOTO, Univ. of California, Agricultural Experiment Sta., *Riverside, California* 92502 (CA-R0-PLS-2513)

OBJECTIVE: Determine the molecular reaction mechanisms for the action of chemical plant growth regulators and herbicides.

APPROACH: The work will involve a molecular chemical study directed at obtaining information relevant to the mechanism of action of chemical plant growth regulators and herbicides including: model reactions and systems for the action of ethylene and for the production of ethylene; elucidation of the reaction mechanism for the decomposition of herbicides with the aim of understanding the reactions of these materials when applied in the field; and find and study molecules of known structure and systems which will help to understand the molecular details involved in the process of biological electron transport.

PROGRESS: The production of ethylene from beta hydroxyethyl hydrazine, BOH, has been shown to be an oxygen requiring metal ion (Fe) catalyzed reaction. Spray treatment of etiolated pea seedlings with solutions of BOH produces the characteristic triple response to ethylene. Ethyl propylphosphonate has been shown to form ethylene and propylene in a reaction with oxygen and ferrous ions. Only a partial response by etiolated pea seedlings was obtained and the possibility of propylene functioning as an anti ethylene agent is suggested.

SUPPORTED BY California State Government - Sacramento

4.0564, BIOLOGY, ECOLOGY, CONTROL AND BEHAVIOR OF HIPPELATES EYE GNATS

M.S. MULLA, Univ. of California, Agricultural Experiment Sta., *Riverside, California* 92502 (CA-R0-SSE-1929)

OBJECTIVE: Develop and put into practice new tools and measures for the suppression of pestiferous Hippelates populations and to study the ramifications of the eye gnat problem effecting public health and economic conditions of people.

APPROACH: Management of breeding grounds sterilization techniques by radiation and chemosterilants. Basic biological, ecological, and pertinent behavioristic data. The role of eye gnats in the epidemiology of Koch-Weeks conjunctivitis, a serious eye disease of children, will be elucidated. Basic studies on attractants and repellents for use against eye gnats are contempleted. Effective attractants and repellents, if found, will materially aid in the fight against eye gnats.

PROGRESS: Eye gnats in the Coachella Valley were found to have acquired tolerance to Trithion, an organophosphate insecticide currently used for gnat control as a soil treatment. This material has been used for 5-6 years and the development of resistance was expected. Semi- field tests with 'Fly Bait' were conducted. In all tests there was a reduction in adult eye gnats. Recovery of population depended upon the breeding level of eye gnats and proximity to other gnat-infested areas. 'Fly Bait' was found to require moisture in the soil for activation and the longevity of the bait was anywhere from 1-3 days. These two aspects of the bait will be further studied so that efficacy of the bait can be improved.

SUPPORTED BY California State Government - Sacramento

4.0565, INTEGRATED BIOLOGICAL-SYSTEMIC INSECTICIDE CONTROL OF COTTON

V.M. STERN, Univ. of California, School of Agriculture, *Riverside, California* 92502

The Research: Currently available systemics, and several conventional insecticides having varying degrees of selectiviy, are Suitable for the research required to develop a sound basis for integrated or combination control programs of the type described. The research could be most effectively done in an area where the problem would not be complicated by the need for repeated applications of insecticides to control boll weevils. Major lines of investigation would include: 1. Biology and ecology studies of insect parasites and predators to determine the ones that should be protected by selective insecticides. 2. Toxicology studies of promising selective insecticides for parasites and predators to be protected. 3. Development of mass rearing techniques for selected parasites and predators to be distributed in cotton fields.

SUPPORTED BY Cotton Incorporated - Raleigh, N.C.

4.0566, CURRENT FISH AND WILDLIFE PESTICIDE PROBLEMS

W. GRIFFITH, State Dept. of Fish & Game, *Sacramento, California* 95819

Study Objectives: 1. Promote the development of pesticide use practices and pesticide regulation to adequately safeguard fish and wildlife and their environment. 2. Field test for toxicity and hazard the pesticides that appear to have the greatest potential for fish and wildlife damage.

Job Objectives: To evaluate those fish and wildlife pesticide problems and relationships that are currently of greatest concern to the Department. Concern is based on potential hazard to wild animals of certain experimental pesticides and pesticides used in operational pest control programs. The investigations are aimed primarily at: 1. developing information regarding the hazard of these chemicals under field conditions, and 2. developing a guide for establishing adequate safeguards for fish and wildlife. Special attention will be given to the hazards to game and nongame species created by the organic phosphates in cotton culture, and polychlorinated biphenyls (PCB) in eggs of raptors and water associated birds.

Procedures: (a) Evaluate the hazard of mercurial seed dressings to birds. A survey will be made to determine the amounts of the different mercurials being used in California. An assessment will be made of the comparative hazard of alkyl mercury seed dressing and other types of mercury seed dressings. Caged pheasants will be fed grain treated with alkyl mercury and another type of mercury fungicide to determine the effect on the test animals and the amount and type of mercury accumulated in tissues. Pheasants will be collected in areas where alkyl mercury and other mercury seed dressings have been used extensively over a period of years. The birds will be examined for gross pathology and tissues analyzed for mercury content. (b) Evaluate the effects on nontarget wildlife of Diphacin, and Endrin treated conifer and brush seeds in both field and forest rodent control programs.

The experimental application of the anticoagulant Diphacin for ground squirrel control may also be carried out in one or more of these by agricultural agencies. Evaluation of side effects of these experimental applications and other suitable tests will be made.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0567, BIOTELEMETRY AS A TOOL FOR PESTICIDE INVESTIGATIONS

H. HAGEN, State Dept. of Fish & Game, *Sacramento, California* 95819

Study Objectives: 1. Promote the development of pesticide use practices and pesticide regulations to adequately safeguard fish and wildlife and their environment. 2. Field test for toxicity and hazard the pesticides that appear to have the greatest potential for fish and wildlife damage.

Job Objectives: Apply biotelemetry techniques as a tool in field investgations of the effects of pesticides on nontarget wildlife.

Procedures: Develop and maintain necessary transmitting and receiving (detecting) equipment to study the movement of wildlife. Adapt techniques presently used by other investigators for studies with birds, primarily pheasants. Test birds, with transmitters attached, will be used to monitor the effects of pesticide used in agriculture and forestry. Test birds will be released and allowed to receive normal exposure to pesticides in treated areas. Biotelemetry will be employed in following the movements of test birds during the trial and in locating and recovering test animals during and after the trials.

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SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0568, CHOLINESTERASE ACTIVITY AND BLOOD ENZYME CHANGE STUDIES

UNKNOWN, State Dept. of Fish & Game, *Sacramento, California* 95819

Study Objectives: Conduct appropriate field and laboratory tests to diagnose pesticide caused fish and wildlife losses and monitor levels of pesticide contamination of fish and wildlife and their environment.

Provide assurance that the economic contribution of both game and nongame species of fish and wildlife is not adversely influenced by unwarranted side effects of pesticides.

Job Objectives: To establish normal cholinesterase activity levels in blood and brain tissue of various game animals and fish as basis for diagnosing intoxication by insecticides that inhibit activity of this enzyme.

This job is being deleted from our work schedule. Almost nothing has been done on this job because of the demand for our effort on such emergency problems as mercury in pheasants and fish.

We do not contemplate the revival of this job since there are favorable indications that more specific diagnosis of organic phosphate poisoning may be more easily obtained.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0569, TOLERANCE OF ORGANIC PHOSPHATES IN MAN

J.A. RIDER, Franklin Hospital, *San Francisco, California* 94114

Studies to determine the levels of minimal incipient toxicity for guthion and methyl parathion in human volunteers will continue. The next dose level for guthion will be 7.0 mg/day and in each study the level will be increased by 1.0 mg until cholinesterase depression is produced. Methyl parathion will be fed at 22 mg/day and increased by 2 mg in succeeding studies. If toxic levels are established for these compounds, studies will be initiated with trithion, phosdrin or ethion.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0570, STUDIES ON THE ECOLOGICAL PHYSIOLOGY OF MIDWATER CRUSTACEANS

J.J. CHILDRESS, Univ. of California, Graduate School, *Santa Barbara, California* 93106

Funds from this grant support a broadly based project on the ecological physiology of deep-sea crustaceans. The study examines respiration 'per se' as well as those parameters of respiration which are pertinent to deep-sea organisms inhabiting the ocean off Southern California.

Four experimental approaches are applied to the problem of respiration in these animals: (1) laboratory maintenance of deep-sea crustaceans and measurement of their growth rates and carbon budgets; (2) analysis of the physiology of oxygen uptake in those organisms which require very little oxygen; (3) measurements of the effects of different temperatures, pressures and light conditions on their rate of respiration and activity; and (4) analysis of their tissues for protein, carbohydrate, lipid nitrogen, carbon and pesticide residues. These observations will provide the necessary data for construction of a quantitative model of the trophic structure of the deep-sea off Southern California as well as providing considerable insight into the respiratory adaptations of deep-sea animals.

SUPPORTED BY U.S. National Science Foundation

4.0571, RESEARCH ON EFFECTS OF PESTICIDES ON FARM WORKERS

UNKNOWN, Salud Incorporated, *Woodville, California*

No summary has been provided to the Science Information Exchange.

SUPPORTED BY Field Foundation Inc. - New York, N.Y.

4.0572, EFFECT JU PHENOBARBITAL SUR LE METABOLISME DU DDT CHEZ LE RAT

J. BRODEUR, Univ. of Montreal, *Montreal, Quebec, Canada*

No summary has been provided to the Science Information Exchange.

SUPPORTED BY Canadian Government - Ottawa

4.0573, PESTICIDES IN MAN

J.R. BROWN, Univ. of Toronto, School of Public Hlth, *Toronto, Ontario, Canada*

No summary has been provided to the Science Information Exchange.

SUPPORTED BY Canadian Government - Ottawa

4.0574, EFFECTS OF SAGEBRUSH CONTROL ON DISTRIBUTION AND ABUNDANCE OF SAGE GROUSE

UNKNOWN, State Div. of Game Fish & Pks., *Denver, Colorado* 80203

Objective: To determine the effects of 2,4-D spraying of sagebrush on 1) sage grouse abundance, 2) sage grouse distribution and 3) vegetative composition and density.

Procedures: 1. To investigate the seasonal distribution of sage grouse after sagebrush is controlled. 2. To investigate sage grouse numbers by age and sex classes on and adjacent to the area treated.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0575, WILDLIFE VS. BIDRIN AND DIMETHOATE USE IN SEED ORCHARDS

J.O. KEITH, U.S. Dept. of the Interior, Bureau of Sport Fish. & Wlife., *Denver, Colorado* 80225

Objective: To determine if the use of Bidrin and Dimethoate for the control of cone insects in conifer seed orchards poses any hazard to wildlife.

Procedures: (1) Visit Denny Creek Seed Orchard, Olympic National Forest, to assess the potential for hazard, i.e., type of habitat treated, presence and abundance of wildlife and uses made of habitat by wildlife during spray periods. If potential hazards exist, (2) document effects of spraying on mortality, food habits and movements of birds and mammals in treated areas, (3) determine persistence of chemicals in various environmental substrates after spraying, (4) assess which wildlife species are related or dependent upon components in which high residues persist, and (5) investigate relationship of spraying to biology and productivity of most sensitive or susceptible species.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0576, EFFECTS OF THE CHEMOSTERILANT, TEPA, ON INSECTIVOROUS SONGBIRDS

J.O. KEITH, U.S. Dept. of the Interior, Bureau of Sport Fish. & Wlife., *Denver, Colorado* 80225

Objectives: To determine (1) the effects of tepa on mortality and reproduction of songbirds, and (2) the hazard to songbirds of releasing tepa-sterilized codling moths into apple orchards near Yakima, Washington.

Procedures: Evaluation will be made of several possible effects of tepa on birds and the course and extent of this work will be directed by preliminary results. This investigation will proceed through the following steps: (1) Acute toxicity of tepa to tricolored blackbirds, (2) Chronic toxicity of tepa-treated codling moths to captive blackbirds, (3) Consumption by songbirds of tepa-treated moths released in experimental orchards near Yakima, Washington, (4) Assessment of bird mortality in experimental orchards related to tepa exposure, (5) Effects of tepa on reproduction in captive blackbirds, and (6) Effects of tepa on bird reproduction in experimental orchards.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0577, FIELD TRIALS WITH ANTIFERTILITY AGENTS FOR PREDATOR CONTROL

S.B. LINHART, U.S. Dept. of the Interior, Bureau of Sport Fish. & Wlife., *Denver, Colorado* 80225

Objectives: 1. To determine the effect of antifertility agents on coyote reproduction under field conditions. 2. To develop the most effective, selective, and economical techniques for applying antifertility agents under varying field conditions. 3. To determine their effects on reproductive rates on nontarget species.

Procedures: Field trials are conducted in western United States under different ecological conditions and with varying coyote population densities. Antifertility compounds are incorporated into tallow drop baits and distributed in the study areas during the breeding season. Baits are applied by airplane, from the ground, or by both techniques. Frequency of bait distribution, method of bait placement, and type of bait are altered to ascertain the most effective techniques.

Study areas are trapped after the breeding season to recover reproductive tracts. Coyote reproductive rates on the study area are compared with that of controls to determine the effects of treatment. Treated animals are identified by a long-term marker incorporated into the antifertility baits. Reproductive tracts are collected from other species present in the study area and the presence or absence of a bait- induced marker noted. Reproductive success is compared to that of controls.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0578, LITERATURE SEARCH FOR BIOLOGICALLY ACTIVE COMPOUNDS

V.A. PERRY, U.S. Dept. of the Interior, Bureau of Sport Fish. & Wlife., *Denver, Colorado* 80225

Objectives: To collect data on chemicals that show biological or other activity that indicate they may have potential value for altering or modifying poison action of animal control agents or for antidotal use.

To identify 'Class Compounds' having the greatest potential for pesticide or antidotal studies.

Procedures: (1) To survey such literature as Chemical Abstracts, Biological Abstracts and periodical journals of Chemistry, Biology and related fields of study for data pertinent to this activity, (2) Through the procurement of text or reference books, (3) By correspondence with chemical or drug manufacturers and authorities in the field of pesticides for data on experimental compounds, (4) To compile this data in a useful form and increase library facilities.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0579, TOXIC CHEMICALS FOR ALLEVIATING BIRD PROBLEMS

E.W. SCHAFER, U.S. Dept. of the Interior, Bureau of Sport Fish. & Wlife., *Denver, Colorado* 80225

Objectives: To find and develop safe and effective chemicals for alleviating bird problems by reductional control of the offending avians.

Procedures: Candidate chemicals are solicited from cooperating companies and screened on starlings and red-winged blackbirds for lethal effects. Acute oral toxicity is determined first; for those compounds active at 10 mg/kg or less, dermal toxicity is also determined. Development is centered on those chemicals that are specifically toxic to target species and the toxicity of an effective agent is also determined on a variety of nontarget birds (pheasants, ducks, hawks, etc.). Field application of safe and effective avicides are made and evaluated in feeding and roosting areas of populations of birds causing problems.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0580, EFFECTS OF HERBICIDES ON USE OF SAGEBRUSH LANDS BY WILDLIFE

M.H. SCHROEDER, U.S. Dept. of the Interior, Bureau of Sport Fish. & Wlife., *Denver, Colorado* 80225

Objectives: (1) To determine effects of herbicide spraying on suitability of habitat for sage grouse, deer, elk, and other wildlife. (2) To find out how wildlife use changes with elapsed time after spraying for sagebrush control. (3) To learn whether methods of partial sagebrush kill, such as strip spraying, can minimize harm to wildlife or can improve habitat for wildlife. Emphasis of this project is on sage grouse.

Procedures: Areas that have been sprayed at various time intervals after treatment will be studied to determine stages of vegetative succession and degrees of wildlife use. These will be measured by means of 1/100-acre belt transects and 1/10-acre site descriptions. Game use will be observed directly in winter and related to availability of surviving sagebrush under snow cover.

Food habits analysis, telemetry, automatic photo-recorders and other advanced instruments will be used to the extent feasible to obtain data on special aspects of the problem. New techniques will be devised as needed.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0581, TOXICOLOGY OF SELECTED PESTICIDES IN SELECTED WILDLIFE SPECIES

R.K. TUCKER, U.S. Dept. of the Interior, Bureau of Sport Fish. & Wlife., *Denver, Colorado* 80225

Objectives: (1) To determine the acute, subacute, and chronic toxicity of pesticides to wildlife; (2) to determine effects of pesticides on reproduction; (3) To determine effects of stresses or diet on selected wildlife species; (4) To determine the fate or metabolism of pesticides and gross pathological effects in wildlife; (5) To relate laboratory findings to field situations in order to predict field hazards of new pesticide uses.

Procedures: Animals for use in penned tests are mostly mallards, pheasants, bobwhite, valley quail, and mule deer. Toxicity tests on captive animals are conducted by standard procedures described in toxocological literature. Most acute toxicity testing is done by the method of Thompson and Weil using single oral doses administered in capsule. Subacute tests measure the tolerance to daily oral doses continued for 30 days. Chronic tests measure effects of pesticides in the diet continuously for periods greater than 30 days. Observations are made of symptoms and behavior. Necropsies, blood tests, and chemical analyses are performed on selected test animals.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0582, LIPOLYSIS OF MILK AND OTHER ANIMAL FATS AS INFLUENCED BY PESTICIDE RESIDUES

R.G. JENSEN, Univ. of Connecticut, Agricultural Experiment Sta., *Storrs, Connecticut* 06268 (CONS00352)

OBJECTIVE: Determine influence of pesticides on activity and specificity of milk and pancreatic lipases toward milk fat, lard and synthetic fats. Determine influence of lipases on pesticides. Relate findings in marketability as regards hydrolytic and oxidative rancidity with taste panels and chemical tests.

APPROACH: Various levels of pesticides will be added to milk fat, lard and synthetic fats to study rates and specificities of lipases. Concentrations of pesticides will be followed by gas liquid chromatography to determine if hydrolysis occurs. Taste panels and determinations of acid degree values and peroxide values will be used to ascertain the marketability of milk.

PROGRESS: Relatively large quantities of Parathion, diethyl-p- nitro phosphate, Sevin and 2,2-dimethyl-7-benzofuranyl-N-methyl carbamate were necessary to inhibit pancreatic, Geotrichum candidum and Vernonia anthelmintica seed lipases. This was apparently due to the requirement that the inhibitor be emulsified as the compounds were more active in this condition. DDT and dieldrin were not inhibitory.

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SUPPORTED BY U.S. Dept. of Agriculture

4.0583, THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE - STUDIES ON THE BIOLOGY AND STERILIZATION OF THE COFFEE LEAF MINER

K.P. KATIYAR, Inter Amer. Inst. of Agr. Sc., *Turrialba, Costa Rica* (AT(30-1)-2043)

The coffee leaf miner is a very serious pest of coffee in all the coffee growing countries of the world. The only satisfactory control of this insect is application of systemic insecticides which are highly hazardous both for human and animal health. Moreover, during the last decade intensive use of pesticides has enabled many insect species to develop resistance to several powerful insecticides. It is, therefore, very important to develop other alternative control methods for this insect. Under this project studies are being made in the laboratory to determine the feasibilities of controlling or eradicating this insect by gamma sterile male technique.

Last year our laboratory insect culture got contaminated with some unknown pathogens which eliminated the entire laboratory population and thus no work could be carried out under this project. Now we have built up a new insect colony and experiments are underway to determine the suitable sterilization dose, effect of irradiation on the longevity of the treated moths. Tests will also be carried out to evaluate the mating competitiveness of sterile males with normal males in inseminating normal females. Part 10 of 10.

SUPPORTED BY U.S. Atomic Energy Commission

4.0584, FUNDAMENTAL APPROACHES TO DRUG TOXICITY

H.G. MANDEL, George Washington University, School of Medicine, *Washington, District of Columbia* 20037

Dr. Fabro is studying the toxicological importance of the presence of drugs in the uterine lumen and the effects of the maternal administration of drugs on fetal biochemistry. Control of fertility will be attempted by administering anti-blastocyst antibodies to rabbits during the preimplantation states of pregnancy. Dr. Mazel is continuing his studies on the mechanism of microsomal enzyme induction, particularly of those enzymes involved in sulfoxide and sulfone formation, 6-methyl-mercaptopurine metabolism, and methylsalicylate and salicylate metabolism. Dr. Jondorf plans to continue studies on emetine and other antiprotozoal drugs with particular emphasis on effects on protein biosynthesis, drug metabolizing enzyme activity and anti- leukemic activity. Structure-activity relationships among various quinoline and isoquinoline derivatives will be elaborated. Dr. Cohn is preparing sufficient purified imidazole-N-methyltransferase to identify the active site on the enzyme and the mechanism by which drugs inhibit it. The pharmacological significance of this in vitro enzyme inhibition will be assessed. The role of lymphatic absorption will be assessed for drugs in relation to their molecular weight, lipid solubility and degree of ionization. Dr. Schechter is studying the potentiation by epinephrine of the hypnotic action of barbiturates. Dr. Kim plans to continue to investigate the significance of the increased DAO activity during pregnancy and the mechanism of action by which intrauterine foreign bodies are able to control fertility. Dr. Straw is investigating the effects of o,p'-DDD, a metabolite of DDT, on the conversion of cholesterol into pregnenolone in mitochondria of testes. Chronic exposure to DDT may interfere with steroid hormone production in the testes. Dr. Fitzgerald intends to investigate the mechanism by which salicylate and benzoate inhibit the synthesis of RNA and the aggregation of ribosome subunits of microorganisms. Dr. Klubes is investigating whether chlorpromazine interferes with nucleic acid base incorporation in the rat brain as it does in bacteria and tumor cells.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0585, IDENTIFICATION, BIOLOGY AND CONTROL OF INSECTS ATTACKING SWEET CORN

M.J. JANES, Everglades Agric. Expt. Sta., *Belle Glade, Florida* 33430 (FLA-EV-01222)

OBJECTIVE: Identify sweet corn insect pests. Study their economic importance, biology and control. Coordinate natural, cultural, physical, biological, and chemical control measures with other cultural practices.

APPROACH: Natural populations of corn pests will be sampled to delineate the time of occurrence and relative numbers of each insect species. The effects of varying numbers of worms per plant and physical damage will be related to yields to establish the economic damage levels. Chemical control tests of materials for use in earworm and budworm control will be conducted at different population levels. The method of application, timing, formulation dosage, effect on parasites and predators and residues will be investigated.

PROGRESS: In corn stem weevil control tests on sweet corn, an application of parathion-methylparathion (6 plus 3 pounds per gallon) used at 4 lb AI/acre applied broadcast prior to seeding, as for wireworm control, resulted in 88 percent uninjured plants compared to 38 percent injury free plants in untreated plots. In plots receiving foliar application of various chemicals, at 0.5 lb or more per acre, in addition to soil treatment, the percent of injury free plants was 97- 100. In budworm control, parathion plus toxaphene, which in the past has been very effective, gave only 73% uninjured plants and was poorer than several other insecticides, the decline being due possibly to increased resistance. Through systemic action carbofuran was effective against the budworm for 30-60 days. Against earworms, Gardona at 1 lb/acre was the most effective treatment. Lannate was effective at 0.5 lb/acre.

SUPPORTED BY Florida State Government - Tallahassee

4.0586, CONTROL OF GLADIOLUS CORM DISEASES

R.O. MAGIE, Gulf Coast Agric. Expt. Sta., *Bradenton, Florida* 33505 (FLA-GC-00502)

OBJECTIVE: Develop more effective control measures for the prevention of corm diseases.

APPROACH: Testing new systemic fungicides and antibiotics for control of Fusarium infections of corms. Study of cumulative effects (3 yrs.) of corm treatments with respect to disease control and flower production. Study of new methods of application of fungicides to reduce personal hazards. Heat treatments of cormels and corms with respect to dormancy of plant material and inducing deeper dormancy. Heat treatments with respect to chemical additives. Modifications of chemical application and use of additives to promote systemic activity of fungicides.

PROGRESS: Thiabendazole as a post-harvest corm dip at 1000 ppm or as a furrow treatment at 6 lb/acre was superior in Fusarium disease control to other fungicides and resulted in larger flowers. Benlate at 1250 and 5000 ppm active as a 15 minute dip at preplant and Benlate applied in planting furrow at 2.5 and 10 lb ai/acre were moderately effective but did not increase flower production and reduced size of flowers and corms. Bromodine and Busan 72 were promising as corm dips on slightly diseased stocks but were relatively ineffective on severely affected stocks. The effectiveness of Dowicide B solution as post-harvest corm dip in control of the disease was significantly reduced as solution pH changed from 9 to 7.5. The treating of successive batches of corms effected this change during one day of use. Parathion emulsion added to corm dip fungicides to control root-knot nematodes was compatible with Thiabendazole but flocculated suspensions of captan, Phaltan, Botran and Daconil 2787. The sequence of applying fungicide and nematicide dips to corms was significant in control of Fusarium disease. Fungicidal dip should follow nematicidal treatment, or they should be combined in one treatment for best control.

SUPPORTED BY Florida State Government - Tallahassee

4.0587, SAFE HANDLING AND DISPOSAL OF MILITARY PESTICIDES

J.C. CORNETTE, U.S. Air Force, Armament Laboratory, *Eglin Air Force Base, Florida* 32542

Technical Objective: The objective of this effort is to provide the Air Force with new technology for safe handling and disposal of military insecticides. A unique noncorrosive, nontoxic enzyme preparation is being investigated for use as a decontaminant on aircraft and support equipment and for protection of personnel and the environment from hazards associated with Air Force insecticide operations.

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0588, DEPRESSION OF BLOOD CHOLINESTERASE ACTIVITY BY ORGANOPHOSPHATE COMPOUNDS

J.A. HIMES, Univ. of Florida, Agricultural Experiment Sta., *Gainesville, Florida* 32601 (FLA-VY-01355)

OBJECTIVE: Determine relationship between depression of cholinesterase activity and appearance of clinical signs of organophosphate toxicity. Determine importance of depression of cholinesterase activity in interactions between organophosphate compounds and other drugs. Characterize time intervals required for regeneration of organophosphate-inhibited cholinesterase.

APPROACH: Red cell and plasma cholinesterase activities will be monitored before and after exposure of experimental animals to organophosphate compounds. Rapidity and degree of cholinesterase depression will be related to appearance of cholinergic signs. Interactions of organophosphate compounds with other chemical agents will be studied, in regard to cholinesterase depression (such as succinylcholine injection in horses). Reactivation and regeneration of organophosphate inhibited cholinesterase will be studied to characterize factors that control these processes.

PROGRESS: As radiotelemetry was utilized to record the electrocardiogram of horses prior to, during, and after the intravenous injection of succinylcholine, there were cardiac irregularities immediately after the horse became recumbent following the injection of succinylcholine. Irregularities consisted of tachycardia, sinus arrhythmia, second degree heart block, ventricular extrasystoles, paroxysmal ventricular tachycardia, and changes in the T-wave configuration. There was an increase in serum potassium following the injection of succinycholine. The period during which this elevation occurred coincided with the period of cardiac irregularities. It appeared that prior administration of atropine would prevent and that pretreatment with promazine would reduce severity of these cardiac arrhythmias.

SUPPORTED BY U.S. Dept. of Agriculture

4.0589, PESTICIDE LEVELS IN MIGRATORY BIRDS

D.W. JOHNSTON, Univ. of Florida, School of Arts, *Gainesville, Florida* 32601

The widespread dissemination of pollutants, especially the persistent pesticides, is now a matter of intense public concern. In aquatic ecosystems mounting evidence indicates biological magnification of pesticides at successive trophic levels, with the top carnivores (fish-eating birds) being severely affected in terms of impaired reproduction and population decline. Practically unstudied, however, are vertebrates in terrestrial ecosystems, specially the masses of insectivorous/granivorous migratory birds that at least potentially ingest pesticide-laden foods, concentrate the pesticides in adipose tissue depots, and utilize most or all of the fat stores in protracted migratory flights. This research will assess pesticide loads in selected migratory species, compare these loads in present individuals with some taken five years previously, compare preflight and postflight loads, and thereby evaluate effects of superconcentrating pesticides in the birds's body as fat stores are metabolized in flight. Secondarily, data will be sought on at least short-term tolerances to specific pesticide loads.

SUPPORTED BY U.S. National Science Foundation

4.0590, EXPERIMENTAL ENVIRONMENTS

N.R. COOLEY, U.S. Environ. Protection Agcy., Office of Res. & Monitoring, *Gulf Breeze, Florida* 32561

Ciliate protozoans, although only a small part of the biomass of marine intertidal beaches, are more numerous as both individuals and species than the metazoans living there. Ciliates have such high rates of nutrient turnover that they may be more important than realized in their role as primary grazers and nutrient regenerators and transporters. They, with bacteria and algae, are the basis of all aquatic food chains. Significant changes in their numbers and metabolic activities should be reflected at other trophic levels.

Objectives: To determine for axenic and gnotobiotic cultures of representative estuarine Protozoa (1) acute and chronic toxicity of selected pesticides, (2) whether genetic resistance to these pesticides develops, (3) ability to concentrate, store and translocate these pesticides to other trophic levels, and (4) effect of these pesticides on utilization of specific required nutrients.

Criteria of effect in (1), (2) and (4) are alteration of population growth rates and generation times and associated dose-response curves, and in (3), gas chromatographic detection and measurement of pesticide residues. Population growth will be determined turbidimetrically; lethality, by failure of concentrated washed cells from experimental cultures to grow when transferred to pesticide-free medium.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

4.0591, PHYSIOLOGY OF ESTUARINE ORGANISMS

D.W. NIMMO, U.S. Environ. Protection Agcy., Office of Res. & Monitoring, *Gulf Breeze, Florida* 32561

The purpose of this research is to determine the physiological effects of low levels of pesticides on estuarine fauna. At present, the research is divided into two areas of interest: (1) the effects of DDT on protein metabolism in shrimp and (2) the kinetics and deposition of C14-labeled pesticides in the tissues of shrimp.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

4.0592, THE STUDY OF THE ECOLOGY OF PESTICIDES

W.B. DEICHMANN, Univ. of Miami, School of Medicine, *Miami, Florida* 33124

Carcinogenicity tests will be completed in (a) rats, following prolonged feeding of DDT, methoxychlor, thiourea, and Aramite; and in (b) mice, following prolonged feeding of dieldrin. Experiments will be completed in the retention of mixtures of pesticides (dieldrin and DDT) in dogs fed aldrin and DDT. The following experiments will be continued: Effects of starvation on (1) mobilization and redistribution of blood and body fat of young, adult and old rats; and (2) hepatic microsomal enzyme activity in rats fed DDT and aldrin singly and in combination. A 'challenging' experiment has been initiated for the purpose of determining compounds (drugs, air pollutants, household chemicals, etc.) and physical factors influencing tissue pesticide concentrations during continuous exposure to a constant dose of a certain pesticide.

Experiments with experimental subjects will be carried out to measure indirectly the effect of pesticides on liver microsomal enzymes activity in occupationally and non-occupationally exposed human subjects. Urine specimens will be analysed in a effort to identify the nature and origin of unidentified peaks in the urine of pesticide formulators and spraymen. Autopsy specimens of fat, spleen, bone marrow and lymphatic tissue from individuals dying of malignant diseases will be analyses for pesticides and compared with specimens obtained from individuals (controls) dying of miscellaneous causes. Blood pesticide concentrations in Argentinian mothers and infants and their relation to lactation will be determined.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0593, EFFECTS OF PESTICIDES ON MARINE ANIMALS

C.E. LANE, Univ. of Miami, School of Marine Science, *Miami, Florida* 33149

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Molting in Crustacea involves the coordinated activity of many independent biochemical mechanisms. Since post-molt 'Penaeus duorarum' apparently absorb dieldrin from sea water at different rates from pre- molt animals, it is proposed to measure absorption and distribution of dieldrin in all stages of the molt cycle in these animals. Using various stages of the life cycle of 'P. duorarum', made available to us by the experimental shrimp-rearing program of the Fisheries Division, we propose to study effects of dieldrin on growth, larval development and metamorphosis, molting and metabolism. The effects of dieldrin on various developmental stages of the sea urchins 'Echinometra' and 'Lytechinus' will be investigated.

SUPPORTED BY U.S. Environ. Protect. Agency - W.Q.O.

4.0594, BEHAVIOR OF ESTUARINE ANIMALS

D.J. HANSEN, U.S. Dept. of the Interior, Bureau of Commercial Fisheries, *Sabine Island, Florida* 32561

Objective: Determine the effects of pesticides on the behavior and physiological tolerances of estuarine animals.

Procedures: A. Using apparatus in which a gradient of pesticide concentrations can be established the ability of selected mollusks, crustaceans and fish to sense and avoid pesticides will be tested. B. Animals will be exposed to pesticide concentrations that they cannot sense and avoid, and the alteration of behavior and physiological tolerances will be determined.

1. Alteration of preferences will be studied in salinity and temperature gradients. 2. After exposure to pesticides, the selected animals will be subjected to extremes of salinity, temperature and other stresses to determine if sensitivity has been changed. 3. Schooling fish will be exposed to pesticides to determine if there are changes in schooling patterns.

SUPPORTED BY U.S. Dept. of Interior - Bu. Comm. Fish

4.0595, LABORATORY BIOASSAYS

J.I. LOWE, U.S. Dept. of the Interior, Bureau of Commercial Fisheries, *Sabine Island, Florida* 32561

The primary objectives of the subject project are: (1) determination of the acute toxic levels of pesticides to representative marine species, and (2) investigation of possible adverse effects of prolonged exposure of marine animals to sublethal concentrations of the common pesticides.

Short-term (96-hour or less) toxicity tests are conducted in the laboratory under controlled conditions. Most of the tests are conducted in constant-flow seawater systems using oysters, shrimp, and marine fish as bioassay animals. These acute toxicity tests will be a continuing function of the project as new chemicals are received for evaluation.

Long-term experiments (3 to 6 months duration) involving the chronic exposure of marine animals to sublethal concentrations of selected pesticides will be conducted when the efforts and results seem justified.

SUPPORTED BY U.S. Dept. of Interior - Bu. Comm. Fish

4.0596, WILDLIFE RESEARCH

L. MARTIN, State Div. of Game & Fish, *Tallahassee, Florida* 32301

Objectives: Inventory the population of brown pelicans in Florida; determine the nature, causes and significance of population fluctuations; detect and learn the causes of abnormal population declines.

Procedures: At least one aerial survey of the coast-line will be conducted each year during the breeding season to locate and census the breeding population.

Several nesting colonies will be kept under close observation so that 'die-offs' can be quickly detected and the causes determined by autopsy of sick and dying specimens. Basic life history information will be secured from these colonies under surveillance.

Specimens will be obtained, when possible, from any 'die-off' that may be detected anywhere in the state, for parasitological examination and chemical contaminant analyses.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0597, DDT AND OTHER CHLORINATED HYDROCARBONS AND EGG SHELL QUALITY

W.M. BRITTON, Univ. of Georgia, Agricultural Experiment Sta., *Athens, Georgia* 30601 (GEO00421)

OBJECTIVE: Examine the effects of DDT and other chlorinated hydrocarbons on the laying chicken, turkey and quail with special emphasis on the egg and egg shell quality.

APPROACH: Short-term and long-term feeding of various levels of DDT and other chlorinated hydrocarbons will be examined for their effect of birds, eggs and egg shell quality. Special emphasis will be placed on the effect of chlorinated hydrocarbons on estrogen metabolism.

PROGRESS: Laying hens were fed either a commercial ration or this ration supplemented with 500 ppm DDT. Birds were killed after 10, 18 and 51 days, their livers removed and the microsomal fraction isolated. Microsomal steroid hydroxylase activity was increased by the feeding of DDT as measured by the conversion of estradiol-17B-4-C to more polar compounds. The results suggest an altered estrogen metabolism in DDT- fed birds. The fat content or fatty acid composition of the fat of the liver or egg yolk was not appreciably altered by DDT feeding. There was an indication that DDT feeding reduced liver cholesterol. Studies are under way to determine if the altered estrogen metabolism in DDT-fed birds influences egg shell quality.

SUPPORTED BY U.S. Dept. of Agriculture

4.0598, RELATIONSHIPS BETWEEN SUB-LETHAL PESTICIDES AND REPRODUCTION AND BEHAVIOR OF FISHES

J.P. KERR, Univ. of Georgia, Graduate School, *Athens, Georgia* 30601

This study proposes to examine the possible effects on the reproductive capacity in a few fish species of periodic and continuous exposures to sublethal concentrations of DDT and perhaps other pesticides.

Objectives: To improve knowledge on the reproductive capacity and behavior of certain fishes, especially the guppy; to assess in laboratory studies the possible effects of chronic and periodic sublethal exposures to pesticides, especially DDT and its derivatives, on the reproductive capacity of fishes, by exposing them to various pesticide concentrations and then noting changes in: (a) reproductive behavior patterns (primary emphasis) (b) general behavior patterns (c) rate of sexual maturation (d) gametogensis (e) gamete viability and fertilization.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0599, DDT IN EGGS AND POULTRY MEAT

D.A. LILLARD, Univ. of Georgia, Agricultural Experiment Sta., *Athens, Georgia* 30601 (GEO-03-0407)

OBJECTIVE: Determine the rate of elimination of DDT residues from the egg and various body tissue of hens. Determine the effects of restricted feeding and induced hyperthyroidism on the rate of DDT residues elimination in the tissue of hens fed DDT.

APPROACH: Groups of hens will be given single dosages of DDT ranging from 0 to 15 PPM. After the various treatments, samples will be collected from the dark and light muscles, the liver, kidney, brain, fatty tissue and eggs. The concentrations of DDT residues will be determined using a gas chromatograph with an electron capture detector. The effect of restricted feeding and induced hyperthyroidism on egg production and mortality of the hens will also be determined.

PROGRESS: Experiments were conducted to determine the effect of forced molt by feed restriction on the rate of elimination of DDT residues from tissue and eggs of hens. It was found that when a laying hen consumes DDT the residues accumulate in the fatty tissue of the hens. The residues are transferred to the egg making them unusable for several months. Restricted feeding had very little effect on the elimination of DDT residues from the fatty

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tissue of hens that were given dosages of 0, 10, 15, 20, 30, 40 ppm DDT for five days. During the restricted feeding period, the egg production of the hens stopped and almost all excess fatty tissue was utilized. Within two weeks after return to full feed, the egg production of the molted hens was greater than that of the hens that were maintained on full feed. The DDT contents of the eggs from both groups of hens were the same. Although restricted feeding does not affect the elimination rate of DDT residues from the egg, it reduces the feed cost and delays the period of peak production of the hens to such time that the residues fall within the legal tolerance level.

SUPPORTED BY Georgia State Government

4.0600, THE D AND THE L ISOMERS OF O,P'-DDT

R.D. KIMBROUGH, Georgia Inst. of Technology, Engineering Experiment Station, *Atlanta, Georgia* 30332

In the proposed work, the D and the L isomers of 2-(o-chlorophenyl)-2-(p-chlorophenyl)-1,1,1-trichloroethane (o,p'-DDT) will be synthesized and the pharmacological action and metabolism of the two substances will be investigated. The pharmacological properties of the 50:50 mixture of D and L o,p'-DDT have been studied, but the components of the mixture have never been studied individually. Technical DDT contains 15 to 25% of the 50:50 mixture of D and L o,p'-DDT, and hence animal exposure to the material is appreciable.

The study of the two isomers of o,p'-DDT will be concerned with an investigation of their individual acute and chronic toxicity in mammals. The storage and metabolism of the compounds will be investigated in order to contribute to the understanding of the storage and metabolism of commercially used technical DDT in animals and man. Since DDT is a widely used pesticide, a better understanding of its metabolism is imperative.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0601, RESPONSES OF DAIRY CATTLE FED FEEDSTUFFS CONTAINING RESIDUES OF CERTAIN AGRICULTURAL CHEMICALS

J.C. JOHNSON, Georgia Coastal Pl. Expt. Sta., *Tifton, Georgia* 31794 (GEO-02-0112)

OBJECTIVE: The objective of this study is to feed dairy cattle feedstuffs containing residues of certain chemicals proposed for use as pesticides and/or herbicides and to determine whether such residues have a toxic and/or repellent effect on the animal and are secreted in the milk.

APPROACH: Forage crops grown according to recommended cultural practices will be sprayed with graduated amounts of chemicals. The harvested forage preserved as hay or silage will be fed to lactating dairy cows. Animal response data to be collected and evaluated included forage intake, health conditions, milk production and chemical residue content of milk. Efforts will be made to design the experiments and collect data in a manner that will be comparable with statistical analyses.

PROGRESS: Silages prepared from corn treated with fenthion, O, O- dimethyl 0- 4-(methylthio)-m-tolyl phosphorothioate (rates of 0, 0.5, 1.0, and 2.0 lb/acre) were each fed to 4 lactating Jersey cows. The total residues of fenthion and its metabolites (mostly fenthion sulfoxide) in corn treated at 2.0 lb/acre dropped from 12.0 ppm (wet basis) on the day after treatment (time of ensiling) to 5.90 ppm after 88 days of aging and then remained rather constant during the ensuing 56 days of feeding. Residues in silage prepared from corn treated at rates of 0.5 and 1.0 lb/acre were somewhat less than expected. Very low levels of total residues of fenthion (0.006 to 0.014 ppm) appeared only in the milk of cows fed silage prepared from corn treated with the highest rate. However, residues were found in the urine (0.004 to 0.160 ppm) and feces (0.003 to 0.156 ppm, wet basis) of all cows consuming silage from treated corn. Levels of blood cholinesterase were depressed only in the animals fed on silage from corn treated at a rate of 2 lb/acre. The general health and silage intakes of the animals and their milk production did not seem to be affected by the insecticide treatments. Investigation of the insecticide Accothion was initiated.

SUPPORTED BY Georgia State Government

4.0602, SOUTHEAST FORAGE INSECT AND INSECTICIDE RESIDUES

D.B. LEUCK, Georgia Coastal Pl. Expt. Sta., *Tifton, Georgia* 31794 (00ENTC0807111300)

OBJECTIVE: Determine the economic importance of insects attacking forage crops in the Southeast. Develop safe effective methods to control the major pests. Investigate the relationships of insects to the incidence of plant diseases. Determine the magnitude of residues of insecticides that appear promising to control insects damaging forage crops; study their persistence and degradation on the crop and in silage made from treated crops; and determine whether feeding treated silages will result in residues in animal products.

APPROACH: Study the habits and damage of insect pests of legumes and forage grasses grown in the Southeast. Develop effective control methods using biological, chemical, cultural, or other means. Investigate the role of insects in the incidence and spread of plant diseases. Apply new insecticides that show promise to control forage insects to different forage crops and supply samples, taken at intervals after treatment, to cooperating chemists for analysis. Ensilage will be prepared from treated forage crops and fed to animals in cooperation with animal husbandry men. Samples of silage and animal products will be analyzed for residues.

PROGRESS: Forage corn and Coastal bermudagrass, treated with phorate at 0.5, 1.0, and 2.0 lbs/acre contained total residues of less than 1.0 ppm of the parent compound and 5 of its metabolites 14 days after treatment. Residues of phorate were relatively stable in jar corn silage for 30 days' storage. Residues of Phosvel, applied to Coastal bermudagrass 1/2, 1.0, and 2.0 lbs/A, were 0.84, 1.73, and 5.28 ppm for the parent compound, and 0.35, 0.66, and 1.30 ppm for its phenol, respectively, 42 days after treatment. Residues of the oxygen analog were less than 0.01 ppm 42 days after treatment. Accothion residues persisted in corn silage for 118 days. The silage fed to cows did not contaminate milk, affect general animal health, or depress cholinesterase significantly. Residues of fenthion were detected in the silage, milk, urine, feces, and aqueous silo seepage when silage from corn treated at 0.5, 1.0, and 2.0 lbs/A was fed to cows for a 56-day period. Significantly depressed acetylcholine hydrolysis occurred, but general animal health was not affected. Two-lined spittlebugs fed on a dilute Karo syrup diet oviposited.

SUPPORTED BY U.S. Dept. of Agriculture

4.0603, RESIDUES IN MILK FROM COWS FED INSECTICIDE-CONTAMINATED FORAGE

W.C. MCCORMICK, Georgia Coastal Pl. Expt. Sta., *Tifton, Georgia* 31794 (033102370111)

OBJECTIVE: Determine the effects of feeding insecticide-contaminated forages on dairy cow health, performance and milk residues. Determine the relationships between insect resistance or insect resistance in forage plants and their nutritive value.

APPROACH: Forage crops will be sprayed with insecticides. Samples will be taken periodically to determine the persistence of the insecticides on the standing crops. Sprayed forages will be harvested, stored, and fed to dairy cows. Persistence of the insecticide during storage, animal performance, and milk residues will be determined during subsequent feeding trials with milking cows. The chemical composition and in vitro digestibility will be determined for forages displaying varying degrees of natural insect resistance and for forages protected from insect damage by various insecticides. Relationships among these characteristics will be studied.

PROGRESS: Silage prepared from corn treated with 1.0, 2.0, and 3.0 lb/acre of Accothion, (0-0-dimethyl-0-4-nitro-m-tolyl phosphorothioate), as an emulsifiable concentrate was fed to lactating Jersey cattle for 8 weeks. Total residues of Accothion (Accothion, its oxygen analog and cresol) in the silage for the 1.0, 2.0 and 3.0 lb/acre rates of application decreased from 4.47, 11.4 and 16.6 ppm on the date of ensiling to 3.41, 6.59, and 9.50 ppm after

118 days of silo storage, respectively. Although traces (0.001 - 0.005 ppm) of the amino analog of Accothion were found in the milk of cows fed the 3 lb/acre silage, no residues were found in the milk of cows consuming silage treated at lesser levels. The urine of cows containing total residues averaging from 0.53 to 5.10 ppm consisted mostly of amino-Accothion plus about 0.1 ppm or less of the parent insecticide and the cresol. Feces of the cows contained low levels of residues (0.04 - 0.18 ppm), primarily amino- Accothion and traces of Accothion. Levels of blood cholinesterase of cows consuming the treated rations were not significantly depressed, and the general health of the animals and their milk production did not appear to be affected.

SUPPORTED BY U.S. Dept. of Agriculture

4.0604, CONTROL METHODS FOR RATS DAMAGING SUGARCANE

G.A. HOOD, U.S. Dept. of the Interior, Bureau of Sport Fish. & Wlfe., *Hilo, Hawaii* 96720

Objective: To develop effective and economical materials and methods for alleviating rat damage to Hawaiian sugarcane.

Procedures: Candidate rodenticides and other control agents are evaluated for toxicity, acceptance of treated baits, and effects upon caged Polynesian rats (Rattus exulans), black rats (R. rattus), and Norway rats (R. norvegicus). Promising materials are field tested. Data prerequisite to registration of control agents is obtained by conducting bioassays on other animals that may be endangered by primary or secondary hazards associated with rat control programs. Attractive and palatable bait carriers are being developed to convey treatments to field populations of rats. Effective methods of bait application are being developed to facilitate efficient population reduction.

SUPPORTED BY U.S. Dept. of Interior - Bu. Sport Fish.

4.0605, BIOLOGICAL AND INTEGRATED CONTROL OF ARTHROPOD PESTS

H.A. BESS, Univ. of Hawaii, Agricultural Experiment Sta., *Honolulu, Hawaii* 96822 (HAW00921)

OBJECTIVE: Obtain information which will make it possible to aid and make the maximum use of biological agents in the control of insect, mite and weed pests and reduce to a minimum the use of pesticides. Follow the progress of newly introduced beneficial species and assess the effectiveness of biological agents on arthropod and weed pests in Hawaii.

APPROACH: Field studies will be made to explore the possibilities for enhancement of the effectiveness of parasites and predators through improvement in food (quality and quantity), shelter (especially protection from wind and rain), continuity of prey (pest) populations in or near the crop areas and reduced damage to them by insecticides (materials and timing of applications). Emphasis will be placed on the influence of continuous pest populations on parasite, predator and prey immigration into nearby new crop plantings and the possible development of improved beneficial species/pest ratios. The effects of pesticide sprays on beneficial species as well as pests will be investigated in field plots and hopefully successful integrated control methods will be devised. Both qualitative and quantitative studies will be made of various pests and/or former pests to determine their pest status and the status of parasites and predators introduced to combat them.

PROGRESS: The weekly population data on the corn leafhopper, Peregrinis maidis, and the egg predator, Cyrtorhinus lividipennis, obtained during 1966, 1967, 1968 and the spring of 1969 are expected to be ready for submission to the Computer Center for computation analysis by the end of January, 1970. Monthly plantings of beans are being made on the Waimanalo Farm and weekly population data on the white fly, Triaeurodea vaporariorum, and its parasites and predators within the plantings are obtained. In addition quantitative population data are obtained on mites and their predators. Several plantings will be studied prior to attempting to prepare the data for computation and analysis through the aid of the Computer Center. One of the graduate students will investigate an aspect of the white fly-parasite-predator study as his thesis research problem and the other student will investigate an aspect of the mite-predator study as his thesis research problem.

SUPPORTED BY U.S. Dept. of Agriculture

4.0606, METABOLISM AND DEPOSITION OF INSECTICIDES IN FOWL

R.B. HERRICK, Univ. of Hawaii, Agricultural Experiment Sta., *Honolulu, Hawaii* 96822

OBJECTIVE: Determine metabolic fate of certain organophosphorus insecticides after ingestion by poultry; determine quantitatively deposition of these insecticides in tissues and eggs after ingestion by poultry; and compare relative toxicity of droppings from hens on insecticide-treated diet to larvae of several species of flies.

APPROACH: Labelled insecticides will be orally administered to mature hens and distribution pattern will be determined using standard radioisotope tracer techniques. Insecticides will be fed to hens and samples of eggs and tissues will be taken for residue analyses. Insecticides will be fed to chickens and toxicity of manure to three species of flies will be determined.

PROGRESS: The acute and subacute toxicity to White Leghorn cockerels of carbamate and organophosphate insecticides were initiated. These include interesting homologous series of phosphonodithioates, oxime phosphates and anilide carbamates.

SUPPORTED BY Hawaii State Government

4.0607, INSECTICIDE METABOLISM AND DEPOSITION OF INSECTICIDES IN THE FOWL

M. SHERMAN, Univ. of Hawaii, Agricultural Experiment Sta., *Honolulu, Hawaii* 96822 (HAW00909)

OBJECTIVE: Determine acute, subacute, and chronic toxicity of insecticides to fowl; the teratogenic effects of insecticides in the fowl; the relative toxicity of droppings from poultry on an insecticide- treated diet to the larvae of several species of flies; the metabolic fate of certain insecticides after ingestion by poultry; and quantitatively the deposition of these insecticides in the tissues and eggs after ingestion by the fowl.

APPROACH: Standard toxicological techniques will be used to determine acute, subacute, subchronic and chronic toxicity to chickens, quail, and fly larvae. Chromatography and radioisotope techniques will be used in the residue determinations and metabolism studies.

PROGRESS: The acute, subacute, and/or subchronic toxicity of 2 insect chemosterilants, 1 phosphate, 5 phosphorothioates, 4 phosphonothioates, 3 phosphonodithioates, 1 phosphoramidothioate, and 1 oxime phosphate to the chick and Japanese quail were determined. Residue analysis of eggs and tissues from hens on a year-long diet containing Nemacide (Reg) (O-(2,4-dichlorophenyl)O,O-diethyl phosphorothioate) were completed. No residues were found in egg whites. Residues in yolks from hens on treatment ranged from 1.28 ppm to 0.10 ppm, depending on level of treatment. Residues above the limits of detectability were present in yolks of hens as long as 13 days after removal from treatment. High levels were also found in tissues of hens with the greatest amount deposited in the fat; ranging from 3.77 ppm in hens receiving 800 ppm in the feed to 0.35 ppm in hens receiving 50 ppm in the feed. Lower levels were found in liver and muscle tissue. After removal from treated feed there was a drop in Nemacide residues related to time. Free 2,4-dichlorophenol was found only in the liver and yolk of eggs of treated hens. Residue analyses were begun on eggs and tissues from hens on a year-long diet of Methyl Trithion.

SUPPORTED BY Hawaii State Government

4.0608, METABOLISM AND DEPOSITION OF INSECTICIDES IN THE FOWL

M. SHERMAN, Univ. of Hawaii, School of Agriculture, *Honolulu, Hawaii* 96822

Previous investigations have shown that the incorporation of certain insecticides in the feed or water of poultry resulted in high mortality among fly larvae in the droppings. However, the inclusion of toxic substances in the diet of domestic animals, accidentally or otherwise, is potentially hazardous. With a view toward clarifying the actual extent of the hazard, emphasis will be placed on: (1) determining quantitatively the deposition of insecticides in the tissues and eggs after ingestion by the fowl; (2) determining the acute, subacute, and chronic toxicity of insecticides to fowl; (3) determining the teratogenic effects of insecticides in the fowl; (4) determining the relative toxicity of droppings from poultry on an insecticide-treated diet to the larvae of several species of flies; and (5) determining the metabolic fate of certain insecticides after ingestion by poultry.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0609, DIELDRIN BUILD-UP AND DISSIPATION RATE IN FATTY TISSUES OF BEEF CATTLE FED DIFFERENT LEVELS OF ALDRIN

T.D. BELL, Univ. of Idaho, Agricultural Experiment Sta., *Moscow, Idaho* 83843 (IDA00505)

OBJECTIVE: Determine the rate of pesticide residue build-up in the fatty tissues of cattle being fed three levels of aldrin and/or dieldrin. Determine the length of time required for complete dissipation of tissue pesticide residues when cattle are placed on a pesticide-free diet following a 140-day period of pesticide feeding.

APPROACH: Feed and fat biopsy samples will be taken periodically during the feeding period and analyzed for aldrin and dieldrin residues. Following the feeding period, fat samples will be taken from the steers at 30-day intervals until the residues have dissipated.

PROGRESS: The status of the problem was again reviewed with representatives of the Idaho Potato Processing Association, since one of the feed sources of dieldrin residues has been the peelings from the potato processing industry. A new peeling process has been developed and is being used on a trial basis by a number of companies. Complete chemical analyses of the mineral content in the peel wastes treated in different ways have been obtained. The analyses indicate that the by product would be a good source of livestock feed, particularly if mixed with other feeds with a low sodium content. Actual feed trials with livestock are needed, however before definite recommendations can be made concerning its feeding value. It is hoped that these trials may be accomplished during the coming year.

SUPPORTED BY Idaho State Government

4.0610, PREVENTION AND DISSIPATION OF PESTICIDE RESIDUES IN THE PRODUCTION OF MARKETABLE MILK AND MEAT PRODUCTS

J.E. MONTOURE, Univ. of Idaho, Agricultural Experiment Sta., *Moscow, Idaho* 83843 (IDA00507)

OBJECTIVE: Develop methods of dissipating various levels of pesticide residues from the fat of milk, blood, tissue and body fat of live animals. Measure the pesticide residues in the blood, urine, muscle and body fat of calves born to or nursing cows contaminated with known amounts of pesticide residues. Determine the level and duration of pesticide residues in dairy products made of milk from contaminated cows. Experimental animals will be contaminated by spraying the animal, adding pesticides to the feed, and by spraying feed crops with pesticides. The pesticide residues in the milk, blood, urine and animal tissues will be determined. Contaminated animals will be put on various rations, such as starvation, high protein, low protein, high fat, low fat, thyroprotein.

APPROACH: Experimental animals will be contaminated by spraying the animal, adding pesticides to the feed, and by spraying feed crops with pesticides. The pesticides used will be those most commonly used in spraying dairy cattle and milking barn and those used for the control of insects on feeds commonly consumed by dairy cattle. The pesticide residues in the milk, blood, urine and animal tissues will be determined by accepted methods for detection. Contaminated animals will be put on various rations, such as starvation, high protein, low protein, high fat, low fat, thyro-protein and others, to try and increase the rate of dissipation of pesticide residues from the body.

PROGRESS: Continued feeding of iodinated casein indicates that such practice may be of limited value in increasing the rate at which chlorinated hydrocarbons are dissipated from lactating and non-lactating dairy animals. This segment of the investigation is being continued. Cheddar cheese is being manufactured from milk containing DDT residues (added just prior to pasteurization). Various samples are being obtained during the manufacturing process. These samples are being analyzed for DDT, DDD, and DDE. Primary objectives are to determine whether residues as the result of artificially spiked samples differ from those of naturally contaminated milk.

SUPPORTED BY U.S. Dept. of Agriculture

4.0611, BIOCHEMICAL BASIS OF ORGANOPHOSPHATE PESTICIDE EFFECTS ON FUNCTION

F.C. HOSKIN, Illinois Inst. of Technology, School of Liberal Arts, *Chicago, Illinois* 60616

The DFP hydrolyzing enzyme (DFPase) from squid head ganglion will be purified. The specificity of the original enzyme source and of the purified enzyme will be tested toward two closely related organophosphate nerve gases, Sarin and Soman. Depending on these findings, these two agents will be tested for their effects on function in the squid giant axon. The purified enzyme will be modified by a Katchalski-type reaction to see in what way its kinetic properties alter.

The effects of a variety of organophosphorus compounds on the resting and action potentials of single electroplax from 'Electrophorus electricus' will be tested. It is my thesis that after a low concentration of the O-P agent, the depolarization subsequently observed on application of AcCh will gradually be reversed by higher concentrations of these compounds. It may be necessary to use a very potent AcChE inhibitor to obtain the initial depolarization, but the subsequent repolarization should be independent of these properties but dependent on its potency as a receptor interactor. This second property should describe a hitherto unrealized explanation for the toxicity of many O-P insecticides.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0612, PHYSIOLOGICAL RESPONSE TO DIETS WITH DIFFERENT FATS AND INSECTICIDES

C.E. POLING, Swift & Company, *Chicago, Illinois* (HN2-43(C))

OBJECTIVE: Compare growth, reproductive performance and survival of three generations of rats fed diets containing different fresh or heated fats with or without insecticides.

APPROACH: From weaning, feed male and female rats diets containing soybean oil, cottonseed oil, lard or hydrogenated vegetable oil with or without chlorinated hydrocarbons. In addition feed diets containing heated cottonseed oil and lard. As insecticides, provide a mixture of chlorinated hydrocarbons (DDT, lindane or methoxychlor) at levels within acceptable limits. Determine fertility and reproductivity of parent generation, survival of offspring to weaning, and growth and reproductivity of some first, second and third generation offspring fed same diet as parents. At death necropsy rats for evidence of pathological changes.

PROGRESS: Feeding studies have been completed. Statistical treatment of the data have also been completed. Final progress report is in preparation.

SUPPORTED BY U.S. Dept. of Agriculture

4.0613, INTERACTIONS OF PESTICIDES, DRUGS AND OTHER CHEMICALS

K.P. DUBOIS, Univ. of Chicago, School of Medicine, *Chicago, Illinois* 60637

The purpose of this program is to continue assessment of the extent to which pesticides, drugs, environmental and industrial chemicals are capable of causing interactions (potentiation and antagonism) in experimental animals using acute toxicity and biochemical measurements of detoxification enzymes as indicators of this effect. The toxicity measurements will be done by simultaneous administration of combinations of compounds and by pretreatment with one agent followed by measurement of the acute toxicity of another compound. Whenever interactions are observed in the acute tests further studies will be carried out at practical dose levels comparable to the therapeutic doses of drugs, the permitted levels of pesticides in the diet, and the maximum allowable air-borne concentrations of industrial chemicals.

At practical dose levels biochemical measurements of enzyme induction will be made. Thus for chemicals that cause interactions through enzyme induction the liver will be assayed for O-demethylase, N-demethylase,and osphorothioate detoxification. Quantitative measurements of enzyme induction in extrahepatic tissues will also be made particularily on the lungs after exposure by the inhalation route. Species differences in response to low levels of enzyme inducing agents will be studied by including mice and quail. Particular attention will be given to classes of pesticides such as chlorinated hydrocarbons and substituted ureas because of needed information concerning the effects of permitted dietary-levels (tolerances) on detoxification enzymes. Throughout the program attention will be given to the development of addditional quantitative methods for measuring enzyme induction. Further studies will be conducted on the inhibitory action of organic phosphate insecticides on a variety of esterases in the rat, and measurements will be made of the levels of aliesterase inhibition that affect the detoxification of drugs.

SUPPORTED BY U.S. Dept. of Hlth. Ed. & Wel. - P.H.S.

4.0614, STUDY OF HERBICIDES SELECTIVITY USING INTRA-SPECIES PLANT INDICATORS

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OBJECTIVE: Determine the degree of tolerance of bentgrass cultivars to siduron. Determine the effect of siduron on root and shoot respiration and photosynthesis. Further work which may be undertaken depending upon results of objective 2. Effect of siduron on cell enlargement or elongation. Determine effect of siduron on the plants' metabolism. Determine the effect of siduron on phosphorus and nucleic acid metabolism if cell division is affected. Determine the metabolism of siduron (siduron C) for susceptible and tolerant cultivars.

APPROACH: Initial work has entailed work on which cultivars are selectively susceptible to siduron. Environmental factors as affecting intra-species selectivity will be studied. The ultimate results of this research are to more clearly recognize the mode of herbicidal action. This should be much easier if the selectivity of herbicide is studied in closely related plants.

PROGRESS: Treatment of pumpkin plants with 2-chloroethylphosphonic acid (CEPHA) induced a greater production of female flowers, shorter internodes and earlier fruit set while treatment with gibberellic acid (GA) induced a greater production of male flowers, longer internodes and later fruit set. Although CEPHA induced the production of a greater number of female flowers, the bulk of the flowers aborted and only a slight increase in the number of fruits per pumpkin plant occurred. The addition of equal concentrations of CEPHA and GA resulted in pumpkin plants with longer internodes and a greater number of female flowers than the untreated plants, although GA partially overcame the effect of CEPHA. The use of CEPHA to increase yield of pumpkins does not appear to be practical under Illinois conditions. In studies with cabbage cultivars differentially affected by nitrofen, it was found that a dark period prior to nitrofen application increased the susceptibility of the cultivar Rio Verde to nitrofen phytotoxicity. However, the addition of sucrose before or after nitrofen application to either the upper or lower leaf surface protected against injury.

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